

INL – The First Five Years



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Prepared by the INL Executive Council

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Executive Summary

In 2004, Battelle, operating through its wholly-owned limited liability company, Battelle Energy Alliance (BEA), proposed to create and lead the new Idaho National Laboratory (INL) and transform it into the preeminent nuclear energy and multi-program national laboratory contemplated by the U.S. Department of Energy's (DOE) bold vision. This vision, which Battelle viewed as having the potential for reshaping the U.S. energy portfolio and important to the nation's energy security, was worthy of a great national laboratory. The BEA Team proposed to first *Transition and Consolidate* Idaho National Engineering and Environmental Laboratory (INEEL) and Argonne National Laboratory–West (ANL-W) into the new INL, and then *Transform* INL into the world-class laboratory that DOE desired. INL's Executive Council,¹ supported by the Office of the Executive Secretariat, conducted this assessment to inform itself, BEA's Board of Managers, and DOE senior management of INL's progress midway through this transformational journey.

By most measures, including DOE Office of Nuclear Energy's (NE) most recent report to the Nuclear Energy Advisory Committee,² BEA's progress to deliver on the Ten-Year Vision for INL has exceeded expectations.

As with any complex endeavor, success is the result of the contributions of many parties. DOE's clear vision in the RFP, BEA's proposal for accomplishing the vision with the assistance of its collaborative partners, and the continued advocacy and alignment of all is what has gotten INL to the point it is now.

The following provides selected highlights from this assessment with more details included in the body of the report:

- BEA rapidly and effectively transitioned and consolidated INEEL and ANL-W into the new INL and established a baseline of services with the Idaho Cleanup Project and other site contractors.
- BEA led INL to become the “National Nuclear Laboratory,” becoming a leading center of technical leadership with individuals possessing technical depth and leadership skills, all of whom work closely with DOE and some of whom are embedded in NE, to deliver some of the world's most impactful nuclear science and engineering.
- BEA is well on its way to building a \$250 million portfolio of relevant and impactful nuclear energy research, development, demonstration, and deployment (RDD&D) programs that are well-synchronized with DOE strategy. The growing nuclear energy RDD&D portfolio is supported by growing, synergistic national and homeland security, energy, and environmental programs.
- BEA expanded INL as a national user facility with growing accessibility to world-class facilities, promoting collaboration and enhancing nuclear engineering education. These combined capabilities provide researchers from universities, industry, and other national laboratories with access to an unmatched array of advanced irradiation and post-irradiation examination capabilities with a highly skilled staff of scientists and engineers to investigate and solve previously intractable problems in fuels and materials.
- BEA delivered on firm direct resource commitments, including substantial bond guarantees, to “jump start” the growth agenda; advance science, engineering, math, and technology (STEM) education; and upgrade key capabilities. The growth agenda has been achieved despite unrealized commercial nuclear programmatic commitments to be moved to or performed at INL.

1. INL's Executive Council consists of INL's Laboratory Director and Deputy Laboratory Directors.

2. Dennis Miotla, Deputy Assistant Secretary, Office of Nuclear Energy, Department of Energy, “Idaho National Laboratory, Five Years Later,” April 2010.

- BEA demonstrated key research results and technical integration among laboratories, universities, and industry as confirmed by peer reviews of national and international technical experts – “*The Committee believes the overall objective of bringing the Nuclear Science and Technology Directorate activities to world-class level and confirming the leadership of INL for the development of future nuclear energy systems, is achievable in a reasonable timeframe*”.³
- BEA, along with the State of Idaho and its research universities built the Center for Advanced Energy Studies (CAES). CAES serves as a public/private partnership comprised of the three Idaho research universities, private industry, and the Idaho National Laboratory, which integrates resources, capabilities and expertise to create new research capabilities, expand researcher-to-researcher collaborations, and enhance energy-related educational opportunities.
- Under BEA’s leadership, annual investment in Laboratory Directed Research and Development (LDRD) has grown to more than \$29 million (3% of total business volume), far exceeding the \$15 million goal in the proposal. The growth in LDRD, mostly funded from cost savings, supports joint appointments, graduate fellowships, intern programs at INL, and development of capabilities.
- BEA established partnerships of strategic importance, significantly enhancing university connections to INL and DOE, while laying the ground work for increased industry engagement. Broad engagement with the university research community has helped develop a culture of research rigor and broaden research community recognition of INL research.
- BEA is helping to create a national renewal in nuclear education and has supported the Idaho research universities in achieving their aspirations of becoming first-tier, nationally-recognized leaders in nuclear education. Within the first five years of INL’s existence, the number of students enrolled in Idaho universities nuclear S&T-related programs has grown nearly 20 fold from about 15 to 250, with equal numbers at the graduate and undergraduate levels.
- BEA consolidated INL around three RDD&D complexes, making significant progress to build or acquire new research and office space while moving out of more than 330,000 square feet of aging, non-mission supportive Laboratory infrastructure. DOE funding for infrastructure has increased from \$91 million in fiscal year 2005 to \$159 million in fiscal year 2010. While important progress has been made, the original condition of the laboratory and the lead time for new facilities make it unlikely that a full complement of world-class capabilities will be in place by 2015.
- BEA has exceeded the production, quality, and security requirements for the Specific Manufacturing Capability (SMC).
- BEA improved compliance and operating efficiency by introducing Battelle’s proven approach to management systems. BEA deployed management systems at INL that are tailored to RDD&D environments. Today, these systems are codified in the Systems Integration Management System (SIMS) and are continually improved by sharing lessons learned among the Battelle-affiliated laboratories. Efficiencies gained through BEA’s approach to laboratory management have resulted in more than \$100 million in savings that have been reinvested to build capabilities, expand LDRD, and upgrade infrastructure.
- BEA sustained strong safety and environmental performance by incorporating best practices and external standards. BEA has reduced employee injury and illness rates, but remains challenged to achieve the proposed goal of a 50% reduction.

3. Jacques Bouchard, CEA, and George Apostolakis, MIT, Co-Chairs of the INL Peer Review Committee, August 2009.

In early 2010, the Laboratory issued the “2012-2021 Ten-Year Site Plan” (TYSP) addressing the following key elements:

- The role of INL in national initiatives
- A description of INL’s near- and long-term missions and associated assumptions
- A Ten-Year End State Vision for INL
- A delineation of INL’s core capabilities
- A delineation of INL’s enabling capabilities
- The investment strategies for INL.

The TYSP has clear, traceable, and close connectivity to the Ten-Year Vision, the 20-Year Report on facility needs for the future of Nuclear Energy RDD&D, and the underlying critical attributes evaluated in this assessment. The Plan provides clear evidence of the long-term sustainability of the DOE/BEA vision for INL.

Throughout this report it is noted that the INL Ten-Year Vision established by DOE and adopted by BEA in the 2005 time frame has remained essentially unchanged throughout the first five years of the BEA contract. The Ten-Year Vision has not changed, but strategies and tactics to achieve the vision have evolved along with U.S. policy emphasis. For the next five years, BEA is expected to pursue aggressively this vision and its underlying critical attributes, although with adaptations in strategies and approaches. The first three years of the contract focused on establishing the foundation, which included consolidation of two laboratories, transformation of legacy processes and infrastructure, and assembling the necessary external networks and advocacy to enable research. In years four through five, advancement of the mission was in the forefront. *The foundation for INL as the national nuclear laboratory has been established. The challenge for the next five years is execution and delivery of results.*

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Battelle Energy Alliance (BEA) INL - The First Five Years Performance Report

1.0 Introduction and Purpose

As part of the bid process in 2004 for the management and operations of INL, DOE articulated and BEA committed to the achievement of a Ten-Year Vision of transformational change at INL. In essence, this vision was to create a “world-class nuclear laboratory” and, thereby, help facilitate the resurgence of nuclear energy in the U.S.

The purpose of this report is to provide a candid evaluation of BEA’s five-year progress toward achieving the INL Ten-Year Vision. The report is written for use by executives and, as such, details have been kept to those essential to allow for a meaningful appraisal of relevance and impact.

2.0 The INL Ten-Year Vision

The vision for INL was initially articulated by DOE in its Request for Proposal (RFP) to manage and operate INL. Subsequently, the basic elements of the vision were validated by the recommendations of the Nuclear Energy Advisory Committee (NEAC, formerly the Nuclear Energy Research Advisory Committee) Subcommittee on Nuclear Laboratory Requirements in 2004.

As part of its successful proposal, BEA formally committed to the Ten-Year Vision that “INL will become the preeminent nuclear energy laboratory with synergistic world-class multi-program capabilities and partnerships.” BEA further noted that this Ten-Year Vision would be accomplished through the achievement of six critical attributes deemed necessary and sufficient to demonstrate accomplishment.⁴

Critical Attribute 1. A portfolio of relevant and impactful nuclear science and technology programs targeting the most demanding research challenges on the path to a technically, economically, and environmentally compelling nuclear energy option for our nation and the world

Critical Attribute 2. A synergistic portfolio of national and homeland security, energy, and environmental programs that leverage INL’s premier nuclear capabilities and make substantial contributions to national missions

Critical Attribute 3. A robust science base that provides the foundation for mission-enabling discoveries, attracts preeminent scientists and engineers to INL’s compelling missions, and creates a culture that fosters scientific inquiry while sustaining a passion for mission accomplishment

Critical Attribute 4. A central role in revitalizing nuclear science, technology, and engineering education and academic research in the U. S., with particular emphasis on helping the Idaho research universities achieve world-class status in these areas

Critical Attribute 5. Extensive collaborations with the world’s premier academic, government, and industrial nuclear science and technology organizations, bringing the full resources of their research base to bear on INL’s demanding missions

Critical Attribute 6. Forefront research facilities, support infrastructure, and management systems essential to delivering world-class research, while operating at the highest standards of safety, environmental protection, and efficiency; and helping to restore public confidence in nuclear energy through operational excellence.

4. BEA Volume II Capabilities and Approach Proposal, Management and Operation of the INL, RFP #DE-RP07-03ID14517

3.0 Evolution of the INL Strategy to Achieve the Ten-Year Vision

While the vision and critical attributes thereof are enduring, the strategies and approaches to achieving them have evolved to better align the Laboratory's people, programs, and capabilities to the "Nuclear Energy Research and Development Roadmap." In so doing, the strategies and approaches initially proposed by BEA have shifted to accommodate DOE strategy in the following ways:

- More explicit linkage of the critical attribute strategies and approaches to DOE research objectives
- Enhanced emphasis on the national user facility concept
- Growth in the total nuclear-related science base throughout the nuclear S&T community, universities, and other national labs, as opposed to just INL
- INL science base more closely tied to nuclear S&T and other mission areas with greater focus on applications and technology deployment.

At present, the critical attributes and refined strategies and approach elements provide clear benchmarks for demonstrating achievement of the Ten-Year Vision, as well as underlying requirements in the INL contract. These elements also provide the basis for the annual Performance Evaluation and Measurement Plan (PEMP) as a means of assuring DOE that contract performance is driving desired outcomes.

4.0 Status of INL Critical Attributes and Vision Accomplishment

The INL Executive Council concluded that the most credible approach to evaluating BEA's five-year progress toward achieving the Ten-Year Vision was to examine known facts about past, present, and expected future performance relative to the expectations defined in the six critical attributes and, based upon professional judgment, assess progress toward achieving the vision.

Today, the vision defines an INL that is a National Nuclear Capability characterized by leadership in technical integration; management and operation of the bulk of the national nuclear research and development infrastructure; overwhelming technical expertise; and relevant and impactful connections to universities, other national laboratories, industry, and international research institutions. Under BEA management, INL has grown from 3,500 to approximately 4,200 employees (a 20% increase). During this same period, the laboratory's annual business volume has increased from \$535 million to \$1 billion (an 87% increase). The disproportionate increase in business volume compared to staff affirms the vision of an INL that recognizes and allows for the contributions of other national laboratories and universities, i.e., major research components of nuclear energy RDD&D led by INL and other labs, according to the strengths of the national labs.

Among the most dramatic changes under BEA management, has been the transformation of the laboratory's nuclear energy research programs. During BEA's first five years, INL has become the "National Nuclear Laboratory," becoming a center of technical leadership with individuals having the technical depth and leadership skills, all of whom work closely with DOE and some of whom are embedded in NE, to deliver some of the world's most impactful nuclear science and engineering. Under BEA, INL has expanded as a national user facility with growing accessibility to users to not only the laboratory's nuclear research capabilities, but also that of other leading research institutions. INL is rapidly becoming a center for nuclear fuels and materials research in the U.S. and a key international hub for nuclear fuels and materials irradiation/post-irradiation examination, with nodes at other research institutions' and universities' research reactors. These combined capabilities provide researchers from universities, industry, and other national laboratories with the unique opportunity to investigate and solve previously intractable problems in fuels and materials.

This assessment will speak to the accomplishments of the last five years mindful that the price of outstanding success is a higher level of expectations in the years ahead. The results of the assessment are presented in the following sections of the report:

- Section 4.1 – Critical Attributes
- Section 4.2 – Resource Commitments
- Section 4.3 – Performance Evaluation and Measurement Plan (PEMP)
- Section 5.0 – Strategic Risks

4.1 Critical Attributes

A summary assessment of performance to the expectations for each of the six critical attributes and associated implementation elements is provided in the subsections below.

4.1.1 Critical Attribute 1—A portfolio of relevant and impactful nuclear science and technology programs targeting the most demanding research challenges on the path to a technically, economically, and environmentally compelling nuclear energy option for our nation and the world

In releasing the Final Request for Proposals to establish INL as a world-class nuclear technology Laboratory, Secretary of Energy Spencer Abraham stressed that, “*Nuclear energy plays a major role in our energy picture today and we believe it can play an even larger role in the future—particularly with the breakthrough technologies that will emerge from this new Laboratory.*” At the time of the proposal, there were multiple nuclear science and technology programs: Generation IV (GEN-IV), Next Generation Nuclear Plant (NGNP), Advanced Fuel Cycle Initiative (AFCI), isotope production, Pu-238, space reactors, radioisotope power systems, and fusion. There were also other Federal agencies, including Naval Reactors, National Aeronautics and Space Administration (NASA), and the Nuclear Regulatory Commission with ongoing nuclear-related RDD&D programs. BEA’s proposal was for INL to build on current support to these programs, while developing new capabilities and innovative and impactful programs, and through global leadership, enhance partnerships to provide those breakthrough technologies. *BEA intended to transform INL into the international laboratory of choice for the performance of nuclear science and technology programs, while growing a \$250 million base of impactful nuclear science and technology programs that were to be an integral part of a global nuclear energy research agenda.*

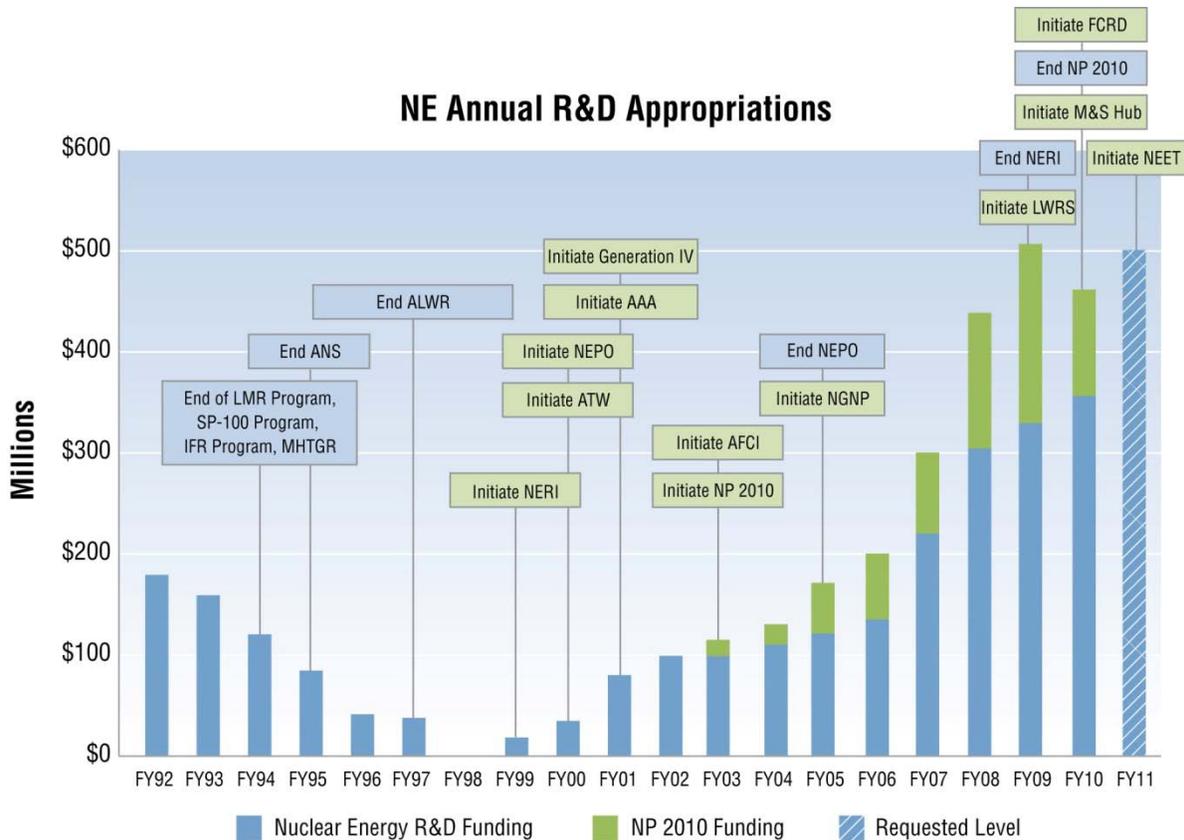
Self-Assessment Results

BEA has been highly successful in supporting DOE’s efforts to develop and implement a focused and impactful nuclear energy strategy for the nation while helping NE grow its budget authority. BEA’s vision and strategy for INL has evolved to transforming INL into an institution that delivers world-leading capabilities that enable DOE mission accomplishment with the Laboratory as the core of the national nuclear capability and at the hub of a national user facility accessible to researchers and experimentalists from national laboratories, universities, industry, other Federal agencies, and international collaborators. In the first five years, BEA has made substantial progress against this critical attribute and project to deliver on the Ten-Year Vision. Here are a few highlights:

- BEA played a leading role in the development of a collaborative U.S. research agenda for nuclear energy. BEA worked with DOE, other Federal agencies (e.g., NRC), industry, national laboratories, and university leaders to help DOE create an integrated nuclear energy research agenda. The disciplined approach to creating such a unified agenda has not only reinforced NE’s national nuclear energy RDD&D integrator role, but also helped establish INL’s leadership across the spectrum of nuclear energy programs. For the NE part of the Laboratory’s mission, INL staff now hold a series of

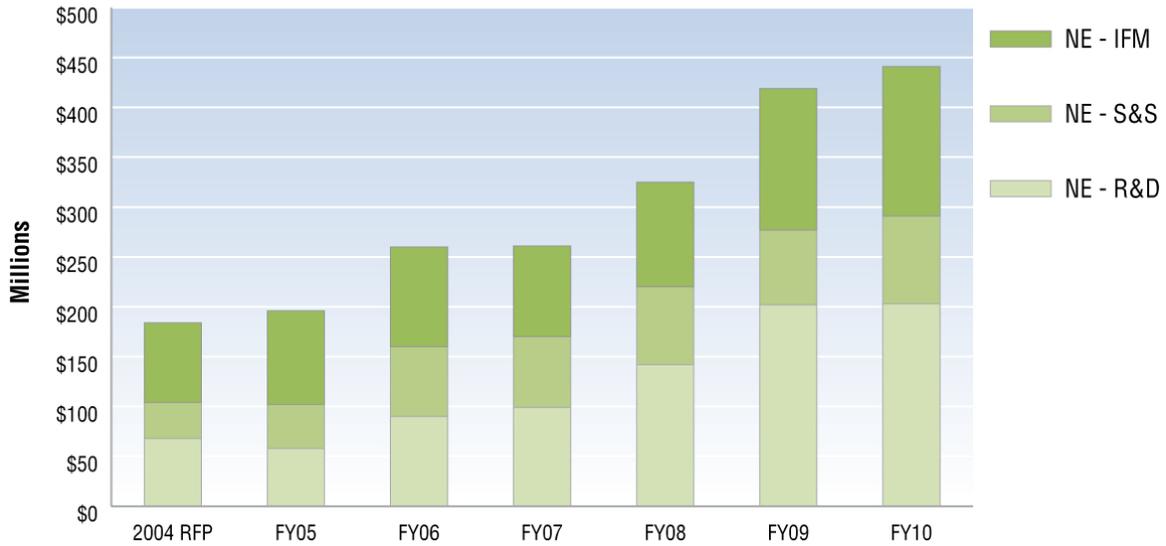
national leadership positions in NE programs and currently lead several key programs with highly impactful results:

- Fuel Cycle R&D
- Light Water Reactor Sustainability Program (LWRS)
- Next Generation Nuclear Plant (NGNP)
- Global presence in nuclear energy arena (GIF leadership positions; increased engagement with India, Republic of South Korea, China, Japan, France, and the United Kingdom).
- Since FY-06 (first full year of BEA contract), NE has seen its congressional appropriations grow as nuclear energy research and development programs became more relevant and impactful to domestic policy and security.



- Nuclear research program growth at INL has substantially exceeded projections made at the time of the proposal. BEA’s proposal put forward an ambitious target of more than tripling INL’s nuclear base programs within ten years; FY-09 numbers indicate that 80% of the ten year growth target was achieved in the first five years. BEA has also been successful in doubling the total NE funding (research, infrastructure, and other defense) dedicated to INL. The growth in nuclear energy-related programs has occurred despite a disappointing level of engagement with industry, which has been hampered by a number of factors: use permit approach and assumptions not realized, Idaho Settlement Agreement restrictions, poor industry experience on the M5 project, DOE terms and conditions for Cooperative Research and Development Agreements (CRADA) and Work for Others (WFO), and the state of the economy in general.

INL Annual NE Funding



- BEA accelerated the entry of new personnel to INL by allocating LDRD funds to support new staff additions; investing fee to attract leading research staff; using the extensive BEA university network to establish joint-research collaborations and appointments that introduce Laboratory researchers to nationally recognized faculty and their students; and creating a “pipeline” for the Laboratory to hire the best and brightest graduating students. To date, BEA has attracted 47 strategic hires to work at the INL.
- Drawing on a \$20 million BEA resource commitment, BEA has made a series of upgrades and improvements in the Advanced Test Reactor (ATR) and its supporting fuel fabrication facility that has equipped it to take on a broader portfolio of customers and programs while continuing to reliably meet the evolving needs of Naval Reactors. For example, BEA built and installed a “Rabbit” to accommodate rapid insertion and removal of irradiated materials or isotope capsules outside the confines of the usual reactor operating cycle.
- In 2007, BEA launched the ATR National Scientific User Facility (ATR NSUF). Through the ATR NSUF, BEA implemented its proposed Hub-Node model as a method for integrating team members’ and collaborators’ considerable resources to augment INL. The ATR NSUF broadly employs the Hub-Node model to integrate and focus the resources of multiple research organizations to achieve outcomes far beyond the capacity of any single institution. To date, the ATR NSUF has led five cycles of experiment awards (resulting in 25 experiments in process) and expanded the concept to other university capabilities (MIT, UNLV, UMi, UWi, IIT, NCSU), while developing ties to other DOE User Facilities (APS, SHaRE).
- Although not in the form originally envisioned, BEA has made progress to establish the capability for fuel and core material research and has long-term plans for future capability growth and relevance in this area.⁵ Through the ATR NSUF and construction and operation of CAES, BEA has been able to accomplish the objectives behind the proposed nuclear material test laboratory.

5. Consolidated World-Class Post-Irradiation Examination Capabilities Strategic Plan, September 2009 and Ceramic Fuels Development Strategic Plan, September 2009.

- BEA established a Center for Advanced Modeling and Simulation (CAMS) to substantially increase capability and connectivity to the Laboratory, university, industry, and international high performance computing community. BEA teamed with Oak Ridge National Laboratory (ORNL) to win an award of up to \$122 million over five years to establish and operate a new Nuclear Energy Modeling and Simulation Energy Innovation Hub. “The Hub,” which includes partners from universities, industry, and other national labs, will use advanced capabilities of the world’s most powerful computers to make significant leaps forward in nuclear reactor design and engineering.

4.1.2 Critical Attribute 2—A synergistic portfolio of national and homeland security, energy, and environmental programs that leverage INL’s premier nuclear capabilities into a truly multi-program National Laboratory that makes substantial contributions to other national missions

In designing a strategy for building a truly multi-program National Laboratory, BEA recognized that the technical capabilities and facilities at INL had the potential to play an even greater role in a series of critical missions of national importance. INL’s core nuclear expertise, extended through the entire nuclear fuel cycle, had broad application to national and homeland security. Because the nuclear nonproliferation mission had well-established competitors, BEA proposed that INL must identify roles for which its expertise made it uniquely suited—roles that leveraged INL programs in nonproliferation—proliferation resistant reactor and fuel cycle design. INL’s largest national security role, the Specific Manufacturing Capability (SMC) program, was scheduled to run through FY–08 and was expected to require a shift in emphasis to sustain the program. Critical Infrastructure Protection (CIP) was expected to receive substantial emphasis, with technical and market success requiring industry engagement. Directly related to CIP was the need to upgrade the nation’s electric grid, an issue with substantial regional importance. Field-scale test beds in infrastructure protection, advanced power grid technology, or nuclear materials detection were difficult to site, and BEA recognized that INL’s location and infrastructure provided it with a competitive advantage. BEA proposed that there was synergy between INL’s nuclear mission and hydrogen infrastructure development; advanced grid technology; and protection of critical energy infrastructure. *BEA’s plan involved building a \$325 million portfolio of national and homeland security, energy, and environmental programs to include a distinct nonproliferation role closely tied to INL’s fuel cycle expertise; leadership in critical infrastructure protection for U.S. nuclear facilities and energy systems; test beds for nonproliferation detection, infrastructure protection, and advanced grid technology; sustained programs at SMC; and a sustained energy and environmental technology role.*

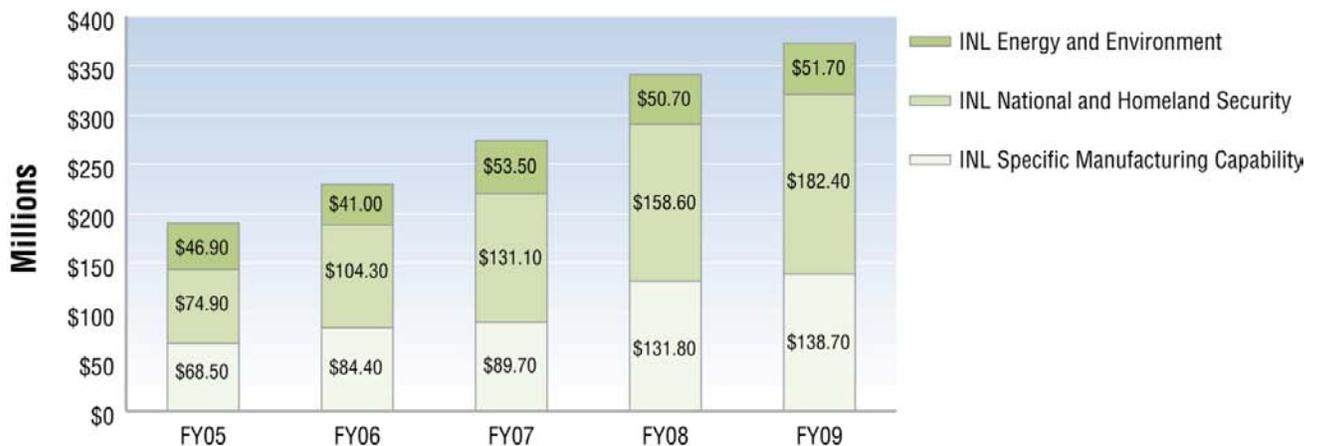
Self-Assessment Results

BEA has been very successful in building a synergistic and balanced portfolio of national and homeland security, energy, and environmental programs that leverage INL’s nuclear energy missions. Under BEA, INL has successfully delivered on mission, built depth through hiring proven talent, established unique capabilities that differentiate INL from other national laboratories, and diversified the client base to provide for focused and sustainable growth as a multi-program National Laboratory:

- INL is recognized as a Center of Excellence for CIP by the U.S. Department of Defense (DoD).
- INL is leading the Nation’s Control System Security program as the operator of the Industrial Control Systems Cyber Emergency Response Team (ICS-CERT) for the U. S. Department of Homeland Security (DHS). INL’s expertise in identifying and reducing vulnerabilities in industrial control systems, including supervisory control and data acquisition systems, distributed control systems, and energy management systems, is internationally recognized. As a leader in this field, BEA operates and maintains a dedicated control systems and cyber security testing center, and manages Federal programs, such as DOE’s National SCADA Test Bed and DHS’s Control System Security Program.

- INL leads key technical programs in support of the Global Threat Reduction Initiative (GTRI) and has been recognized for providing outstanding support for the Russian Research Reactor Fuel Return Program. INL has also led the conversion of domestic research test reactors to low-enriched uranium (LEU) fuel.
- INL’s infrastructure protection programs include the development and use of advanced modeling and simulation technologies that provide quick and reliable analysis of complex infrastructure interactions and interdependencies. INL engineers have developed modeling and simulation tools, such as the Critical Infrastructure Modeling Simulation (CIMS), and the Critical Infrastructure Protection and Resilience Simulator (CIPRSim), which visually portrays the interactions between infrastructure components.
- SMC has been highly successful relative to the BEA proposal by meeting or exceeding contract requirements on time, on budget, and with expected quality; thereby assuring high customer satisfaction.
- INL leads the nation’s efforts in biomass feedstock logistics focusing on technology to economically harvest, collect, store, queue, preprocess, transport, and handle biomass materials to be converted to fuels or power.
- INL is at the forefront of developing and testing the next generation of hybrid and electric vehicle batteries and other technologies. INL provides world-class capability and leadership in testing and evaluating advanced battery, fuel cell, and ultra-capacitor technologies. The Advanced Vehicle Testing Activity provides crucial data for DOE’s technology modeling, simulations, and research and development programs, and is used by fleet managers and other vehicle buyers to make informed decisions about the best vehicles for their operations.
- BEA has achieved its ten-year goal of \$325 million in National and Homeland Security (including SMC) and Energy and Environment Programs in the first five years. While SMC contributes to this total, the goal is still achievable without SMC Program dollars.

N&HS and E&E Program Growth



4.1.3 Critical Attribute 3—A robust science base that provides the foundation for mission-enabling discoveries, attracts preeminent scientists and engineers to INL’s compelling missions, and creates a culture that fosters scientific inquiry, while sustaining a passion for mission accomplishment

At the time of the BEA proposal, both INEEL and ANL-W focused their research agenda on applied science and engineering. There was only a modest and fragmented program base with small pockets of scientific culture. Under BEA, these strengths were to be supported by a robust scientific program base that would better enable INL’s missions. BEA recognized that research markets are highly competitive, requiring a science foundation and a research environment that would attract the best scientists and engineers from around the world. *To establish INL as a world-class multi-program National Laboratory, BEA planned to combine the existing science competencies for the newly merged INL and focus them around “Distinctive Signature” areas directly linked to INL’s future missions. These signature areas would be strengthened through internal investments, new hiring, and partnerships with national laboratories, industry, and academic institutions.*

Self Assessment Results:

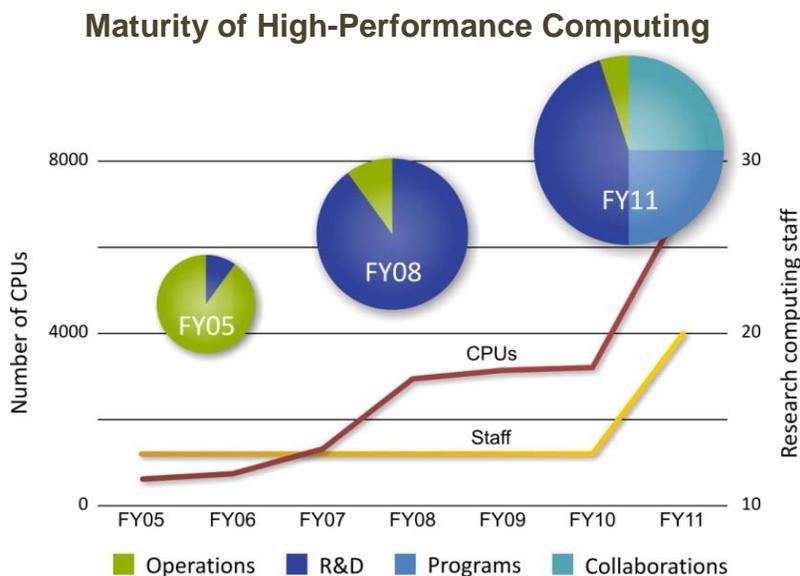
Early in the contract, BEA saw a much greater advantage to focusing its science base initiatives on science programs that directly support the Laboratory’s major mission areas rather than pursue a largely DOE Office of Science-based portfolio. As a result of these decisions, the investments in strategic hiring have been highly directed to leadership and technical expertise in the applied programs (Nuclear and National and Homeland Security). The number of distinctive signature areas was reduced to the three highest priorities (Advanced Fuels and Materials, Separations and Actinide Science, and Instrument Control and Intelligent Systems), and the other areas were folded into base programs. The distinctive signatures have provided a focus for indirect investments that were made to grow a science base that supports INL missions. Indirect investments have been used to attract and retain highly credentialed research staff, bolster the intern program, provide funding for LDRD to stimulate exploration in forefront science, purchase research equipment, and foster collaborations with academia, industry, and other national laboratories.

In 2009, as a matter of policy, the U.S. concluded that new approaches to the management of used nuclear fuel needed to be considered, including opportunities to develop game-changing technological advances over today’s technologies or body of knowledge. BEA concluded that advanced reactor and fuel cycle technologies, and potentially transformational technologies, could be developed through an approach that built upon the scientific advances of the last few decades through a greater understanding of fundamental nuclear science and improvements in scientific computation and other tools, with less reliance on large scale experimentation. BEA presented its ideas regarding this science-based approach to DOE in a series of presentations and white papers that were designed to provide early input to the development of the “Nuclear Energy Research and Development Roadmap.” Overall, this approach focused on increased coupling of theory with fundamental, phenomenological testing, and modeling and simulation to accomplish research objectives. Over the last year, BEA has worked with DOE to extend this approach to virtually all of the NE RDD&D initiatives. In short, BEA leadership in the “Nuclear Energy Research and Development Roadmap,” related implementation plans, along with some of the new programmatic initiatives proposed by DOE and BEA will enable NE to achieve a greater integration among its research initiatives than achieved over the last twenty years.

In conjunction with efforts to focus on establishing a fundamental understanding of the performance of fuels, materials, systems, and components, BEA also began developing the strategic underpinnings of capabilities and infrastructure needed to support such a science-based approach. This resulted in two strategic plans that articulated the strategy for ongoing and future investment over the next several years to establish world-leading capabilities in fuel and materials examination, including the ability to handle

highly radioactive materials and irradiated fuels, and additional capabilities in experimental fuel development. From that, BEA developed a broad strategic plan (the Ten-Year Site Plan) for investment tied to mission accomplishment, as a phased approach that when fully implemented, can deliver world-leading science-based research capabilities. A key part of this strategy is the acquisition of advanced tools and instruments that enable fundamental understanding of the performance of nuclear systems. New instruments and tools are being put into service at the Laboratory today, with more planned for the next several years as BEA completes several key upgrades and new facilities:

- Annual LDRD funding has steadily increased over the past five years and is now stabilized at \$29M (3% of Business Volume), far exceeding BEA’s proposal level of \$15M. The LDRD funding is being used to ensure future nuclear energy capability is in place, build technical staff breadth and depth, leverage multi-program capabilities, and expand partnerships.
- BEA quickly moved to put in place an indirect pool for purchase of general purpose capital equipment (GPCE) for research. For many years, direct-funded GPCE was not available for purchase of research equipment resulting in inadequate upgrades and new equipment purchases to support a robust science base. From cost savings, indirect investments were directed to the purchase of research equipment. In 2010 alone, \$10 million of GPCE dedicated to research is being purchased.
- In the first five years, 47 strategic hires with recognized scientific and technical credentials were made possible by indirect investments, such as LDRD and BEA’s investment of fee. This constitutes 94% of the strategic hiring target in the BEA proposal.
- Significant advancements to high performance computing capabilities for INL science and engineering research were achieved with the establishment of a new scientific computing data center featuring “Icestorm,” a high-capacity SGI supercomputer (ranked 64th in the world upon purchase), and a new high-end Visualization Center. The result has been an increasing trend in high computing use.



- The CAMS has provided human resources, hardware, software, communication, and collaborations to enable the use of state-of-the-art computational tools in the development of advanced energy systems. The Center has focused on three-dimensional transport modeling (neutrons, radiation, heat and

fluids), behavior of solid and fluid material (based on computational material science) under extreme conditions and chemically aggressive environments, design and layout of instrumentation and control systems (monitoring systems of the future), and implementation of appropriate computing infrastructure.

- INL is a key partner of the team led by ORNL to establish and operate a new Nuclear Energy Modeling and Simulation Energy Innovation Hub. INL provides leadership for the Hub by staffing the Deputy Director position. The Hub, which includes partners from universities, industry, and other national labs, will use advanced capabilities of the world’s most powerful computers to make significant leaps forward in nuclear reactor design and engineering. The Hub will allow engineers to create a simulation of a currently operating reactor that will act as a “virtual model” of that reactor. The Hub will then use the “virtual model” to address important questions about reactor operations and safety—reactor power production increases and reactor life and license extensions. The combination of data gained from the “virtual model” and the physical reactor will be used to resolve technology issues confronting nuclear energy development in the near-, mid-, and long-terms.
- The Advanced Fuels and Materials Distinctive Signature area is providing a basic scientific understanding of fabrication process and irradiation performance of fuels and materials at the micro-structural level. This signature area was also instrumental in INL’s success in obtaining the Office of Science-funded Center for Materials Science of Nuclear Fuel, a DOE Energy Frontier Research Center. Funding is for five years at a level of \$2 million per year to create computer models that will predict the behavior of materials in nuclear reactors and then validate those models against actual experiment results.
- The Instrumentation, Control, and Intelligent Systems (ICIS) distinctive signature has focused around a grand challenge in resilient control systems, which utilizes intelligent automation, human systems, and control systems security researchers from across the Laboratory. This multi-disciplinary approach provides the basis for developing a holistic approach to next generation control system designs, and in so doing, a scientific and engineering capability that is unique amongst other national laboratories.
- In the past five years, INL has more than doubled its number of annual publications, this increase can be traced in part to technical leadership roles that INL has taken in organizing and chairing technical sessions in key conferences, such as the ANS National Annual meetings. The proposal envisioned an increase in patents, which has not materialized due to a number of factors.
- INL is currently funding 15 professor/lab collaborations through its joint appointments program. Seven of the appointments benefit Idaho’s three major research institutions—Boise State University, Idaho State University, and the University of Idaho. The joint appointments are a key strategy to both the retention of current educators and researchers, as well as the attraction of new talent that would simultaneously pursue academic and research professional interests.

4.1.4 Critical Attribute 4—A central role in revitalizing nuclear science, technology, and engineering education and academic research in the U. S., with particular emphasis on helping the Idaho research universities achieve world-class status in these areas

At the time of DOE’s award of the Management and Operating contract for INL to BEA, nuclear science and engineering education had been in decline for decades. University nuclear engineering departments were closing down, with the consequence being that the number of U.S. newly trained nuclear scientists and engineers was at an all time low. Additionally, the nuclear workforce was aging, and retirements over the next decade were projected to severely impact the nation’s nuclear energy and national security capabilities. BEA believed that the gateway to a vibrant nuclear power economy was research; research to overcome the technical barriers to high-temperature materials; research that allowed modeling and simulation of new fuel and reactor designs; and research that produced the scientific basis for licensing.

BEA's plan involved leveraging INL mission success and BEA industry partnerships to create exciting opportunities to draw students to nuclear science and technology careers; enhancing academic nuclear research and education nationally and in Idaho through the National University Consortium, Idaho University Collaborators, and the Center for Advanced Energy Studies; strengthening the nuclear S&T pipeline through BEA-funded K-12 and public outreach programs; and providing focus, commitment, and mission integration by creating the position of Director for Education, Training, and Research.

Self-Assessment Results

BEA's efforts in the first five years have created exciting opportunities that have drawn students to nuclear science and technology careers. Idaho universities have enhanced their faculty status and improved their curriculum with growing access to nuclear research opportunities. To date, the number of students enrolled in Idaho universities' nuclear S&T-related programs has grown nearly 20 fold from about 15 to 250, with equal numbers at the graduate and undergraduate levels. Due in large part to the NE University Program—an approach mostly conceived and designed by BEA—there is stronger university support for DOE and laboratory programs with rising recognition for INL and DOE contribution to educational renewal. BEA's approach of partnering to address the entire educational pipeline (K-12 STEM, workforce training, and degree programs) is providing an expanded resource for recruiting, training, and educating skilled technicians, operators, and degreed scientists and engineers:

- BEA played a leading role in forming the NE University Program (NEUP). BEA designed the approach and construct for the program and with DOE's approval has been in the program administrator role. Today the program provides universities with more than \$40 million—through a competitive selection process—to fund basic nuclear energy research, university infrastructure, and invest in the development of nuclear science and engineering students by providing scholarships and fellowships.
- BEA, along with the State of Idaho and its research universities, committed over \$14 million and the associated land to build Center for Advanced Energy Studies (CAES). CAES serves as a focal point for nuclear education, offering summer institutes, visiting appointments, and distance learning programs, all invigorated by coupling to INL research. BEA and its partners expanded on the CAES programs by making senior INL staff available to participate as adjunct faculty at Idaho universities. In the first five years, CAES has grown its research volume from zero to about \$13M per year with an expectation for additional growth in the next five years.
- BEA played a leading role in forming the Idaho STEM initiative (*i-STEM*), a broad and growing partnership of Idaho educators, government, and businesses working to improve STEM education in the state. The *i-STEM* initiative offers comprehensive programs to ensure STEM education reaches all students and teachers statewide. The initiative has provided expense-paid workshops for teachers to explore research-based practices and cross-curricular applications along with specific STEM content. Teachers are taught by experts and professionals in content areas like energy, engineering, environment, space, and robotics.
- BEA teamed with Idaho State University and Partners for Prosperity (a 501(c)(3) community-based organization) to form the Energy Systems Technology and Education Center (ESTEC). The Center addresses the growing shortage of work-ready maintenance and operations technicians in fossil fuels, nuclear power, and renewable energy. This public/private partnership, which was funded with \$2.5 million in grants from the U.S. Department of Labor and the National Science Foundation with an additional \$1.1 million from the State of Idaho, now offers four Associate of Applied Science degrees in Energy Systems Instrumentation and Controls Engineering Technology; Energy Systems Electrical Engineering Technology; Energy Systems Mechanical Engineering Technology; and Energy Systems Wind Engineering Technology.

- BEA led the formation of the Idaho Regional Optical Network (IRON) to enhance high-speed connection with education and research institutions—raising Idaho connectivity to world-class. IRON connects INL, CAES, and Idaho and Washington research institutions and universities to counterpart organizations throughout the country. IRON has been designated as Idaho’s Sponsored Education Group Participant (SEGP) provider for all Idaho schools through Internet2. IRON’s presence in Idaho resulted in a drop in bandwidth costs state-wide by over 50%, making all of Idaho more competitive.
- The INL Internship Program was recognized as one of the top 200 programs in the country by Vault. The internship program touches over 200 students a year, supporting and encouraging them to continue in the fields of science and engineering.

4.1.5 Critical Attribute 5—Extensive collaborations with the world’s premier academic, government, and industrial nuclear science and technology organizations, bringing the full resources of their research base to bear on INL’s demanding missions

Great national laboratories are strongly connected to the international science and technology community. Often, they are the leading centers for broad areas of research, home to unique facilities and outstanding researchers, and attract the world’s best scientists, engineers, and students to the Laboratory. To realize DOE’s vision, BEA proposed that INL must become such a collaborative center for nuclear science and technology. To assure rapid deployment of technology, INL must also be able to perform proprietary work for industry.

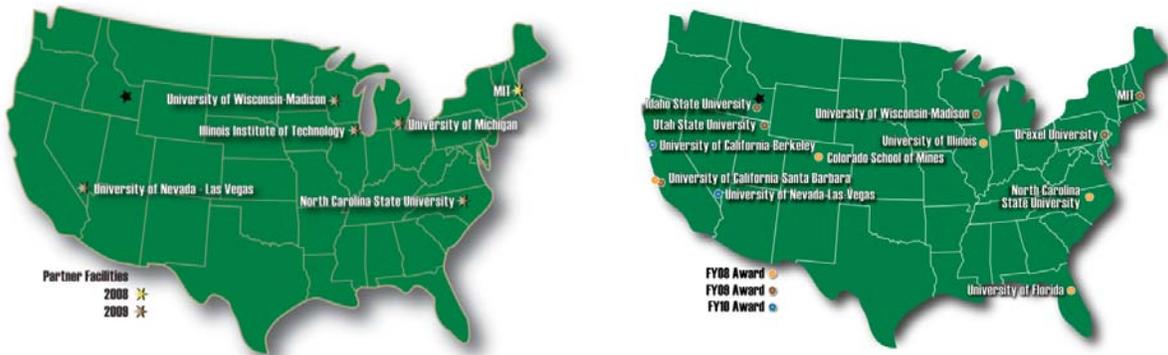
BEA intended for INL to become the international hub of nuclear RDD&D, as well as the focal point for cutting-edge research in nuclear science and technology, engaging leading researchers and attracting students from around the world. BEA industrial partners committed significant resources to participate in INL programs as the most effective way to create and access next-generation nuclear technologies. *BEA’s plan involved providing leadership for partnership formation by creating senior management positions focused on industrial and university relations; expanding capabilities by bringing partner resources to INL mission through the Hub-Node model; growing commercial nuclear business base through leadership from EPRI and by implementing Privately-Funded Technology Transfer (PFTT) and a Use Permit; and invigorating INL science and engineering through high-impact academic collaborations based on the National University Consortium and CAES.*

Self-Assessment Results

Although approached differently than originally proposed, BEA successfully leveraged the designation of the ATR and associated post-irradiation examination facilities as a national scientific user facility to expand collaborations. BEA has achieved significant progress towards successfully establishing the INL as the hub of a national nuclear user capability. Partner resources and capabilities have been engaged to provide even greater opportunities for impactful research. Through CAES, university and academic engagement has prospered. PFTT and Use Permit strategies were not successfully implemented as they were not supported by DOE. The inability to implement these contract tools has adversely impacted BEA’s ability to engage industry in other than traditional methods, which have proven to be performance-limiting:

- DOE designated the ATR and associated post-irradiation examination facilities as the ATR National Scientific User Facility (NSUF) in April 2007. This designation allowed broader access to nuclear energy researchers, helping ensure the long-term viability of nuclear energy through a robust and sustained research and development effort. Researchers from universities, laboratories, and industry collaborating through the ATR NSUF have facilitated the prospect of advancements in basic and applied nuclear research and development to help meet the nation’s energy security needs. ATR NSUF has offered a variety of opportunities for university/educator participation and has two Calls for Proposals each year. Proposals must be led by a U.S. university or college, but collaborations

between institutions are encouraged and collaborative proposals are ranked a bit higher during the selection process. The ATR NSUF also provides internships, scholarships, and opportunities for student participation in Users Week. In its first three years, ATR NSUF has offered a number of experimental opportunities to universities and has partnered to expand capabilities.



- Members of the National University Consortium formed by BEA expanded their support of INL by taking on a greater role as participants in the Institute for Nuclear Energy Science and Technology (INEST). The institute’s goal is to help define INL’s long-term nuclear energy research and development strategy. As part of that team, the schools are working to identify gaps in various aspects of nuclear energy research and suggest how INL can strengthen its programs to address those needs. The institute comprises four Centers of Research and Education (COREs) that focus on nuclear energy areas: fuels and materials, space nuclear research, fuel cycle, and safety and licensing. Each CORE is led by two researchers—one each from INL and its partner universities.

4.1.6 Critical Attribute 6—Forefront research facilities, support infrastructure, and management systems essential to delivering world-class research, while operating at the highest standards of safety, environmental protection, and efficiency; and helping restore public confidence in nuclear energy through operational excellence

At the time of the BEA proposal, both INEEL and ANL-W had demonstrated strong performance with continued improvements in environment, safety, and health and operations. However, the facilities and infrastructure had suffered badly from a long-standing lack of investments resulting in aging facilities that were becoming increasingly less relevant to future INL missions. The combining of two labs that operated under different systems, culture, and leadership would be a particular challenge at the start of the contract. To establish INL as a world-class multi-program National Laboratory, BEA planned to sustain strong safety and environmental performance by incorporating modern standards into the design of research facilities and reduce hazards to staff through elimination of legacy material and by upgrading aging infrastructure. Improved compliance and operating efficiency would be the result of implementing Battelle’s proven approach of laboratory management systems. Reduced indirect costs would be achieved by deploying Battelle’s “Achieving the Competitive Edge” (ACE) process. The final prong of the strategy was facility modernization to improve mission capability and operating efficiency.

Self-Assessment Results

At the time of the RFP and BEA’s proposal, both DOE and BEA underestimated the degradation of the underlying supporting infrastructure. As a result, much of the effort in the first five years involved stabilizing the infrastructure while putting in place the plans that will enable the laboratory to deliver

world-class RDD&D while operating at the highest levels of operational performance, environmental protection, worker safety and health, and efficiency:

- BEA made significant progress providing new and/or upgraded laboratory and office space. However, BEA failed to meet its expectations for providing new buildings and major facilities through third-party leasing mechanisms. BEA pursued this strategy for too long and did not move quickly enough on line items because of the perception of insurmountable DOE constraints on Laboratory growth. INL is currently planning to think bigger and work with DOE and Congressional parties to rectify this situation.
- BEA has fully implemented a full suite of management systems tailored to the needs of a research institution (e.g., ISMS, Work Planning and Control, Occupational Safety and Health, Environmental Management, Project Management, and Business Management). BEA has also worked in partnership with DOE to refine the PEMP process to better focus on driving the strategic agenda of the Laboratory. Collectively, these systems have resulted in notable compliance/operational improvements: validated ISMS system, certified systems to external standards (e.g. ISO 14001); improved health and safety statistics; improved environmental statistics; improved business management performance; improved delivery of contract requirements (e.g., Contract Data Requirements List); and improved contractor assurance. However, although project management system deployment has markedly improved, performance problems with management of projects have persisted since the start of the contract.
- BEA did not implement the formal, third-party process envisioned in the proposal for cost savings. Instead, an internal, ACE-like process was used to demonstrate limited opportunities for savings through this mechanism. Consequently, by mutual BEA and DOE agreement, the 10 year \$200 million cost savings initiative was transformed into a 10 year \$200 million reinvestment initiative, which has been highly successful to date. The prioritized total investment for the first five years is expected to be \$115 million and the corresponding expectation for 10 years is at least \$200 million.
- BEA fully implemented the following institutional and individual performance management systems: a management philosophy of Simultaneous Excellence in science and technology, operations, and community relations; three underlying Management Principles (*outcome orientation in everything we do; clear roles, responsibilities, accountabilities, and authorities; and exemplary professional and personal behavior*); a BEA management policy document addressing all aspects of RDD&D, business, and operational performance; a refined PEMP process with a focus on driving the strategic agenda of the Laboratory; long- and short-term strategic/business planning and associated performance assessment processes for the Laboratory and its organizational elements; individual R2A2s and performance expectations/evaluations for all laboratory personnel with career development plans and succession plans for senior managers and leaders with the intent to implement these at lower levels in the next few years.
- BEA has transformed INL's cyber infrastructure from one large network to a set of customized network segments where risk can be effectively balanced between mission need for collaboration and flexibility with compliance and the dynamic threat. This transformation has produced performance that is leading the DOE complex.
- BEA's planned evolutionary turnover of senior managers has resulted in a current Leadership and Management Team that is more strategically aligned with the Laboratory's vision and a new, more effective and efficient formal process through the Executive Council and its three sub-councils for executing senior management decisions on strategy, policy, resources, and risk management.
- BEA has made significant strides in sustaining public support for INL in large part through its exceptional record of operating performance and community outreach.

- BEA's efforts to revitalize the laboratory have been largely successful, although not as timely as originally envisioned. BEA's approach consolidated INL capabilities around three main campuses. Investments were made to modernize each area and create aesthetics and functions of a campus environment that will attract and retain researchers, while fostering collaboration, communication, and connectivity. Several buildings have been completed or will be completed in FY-2010 that will transform the ATR Complex, improving functionality and efficiency of operations. Among them are the Test Train Assembly Facility, which houses recently purchased advanced tools and equipment for the fabrication and testing of experiment test trains; a new Radiation Measurements Laboratory; a Technical Support Building for the operations and engineering staff; and a Radio-Analytical Chemistry Laboratory. The transformation of the Research and Education Campus (REC) was initiated with the construction of CAES. Several other key facilities were obtained under lease arrangements; these include: the National and Homeland Security High-Bay facility, additional national security offices, and a supply chain management office. Plans are under way to lease two additional facilities (Research and Education Laboratory and a Technology Demonstration Facility). The final complement of facilities will allow INL to vacate old, non-mission capable facilities and consolidate key capabilities in support of the long-term mission of the Laboratory. Efforts have also focused on the Materials and Fuels Complex (MFC), where both a new radiochemistry laboratory and a vehicle test station were completed in FY-2009. Over the next several years, significantly more changes will occur at MFC as modifications to existing facilities are completed for fuel fabrication capabilities, as new facilities come on line to support fuel development and examination, and as efforts proceed to restart the TREAT facility.
- BEA has vacated 337,958 sq ft of space that is no longer needed, no longer capable of performing its intended function, or no longer economically justifiable to support current and/or future INL mission needs. Some of these facilities are cold and dry, while others have been demolished or transferred to the Office of Environmental Management for decontamination and demolition.
- BEA has institutionalized a program to implement sustainable practices in facility design and operation, procurement, and program operations. The program provides measureable and verifiable energy, water, and greenhouse reductions by responsible use and disposal of materials and resources and cost effective facilities, services, and program management.
- BEA's management of legacy nuclear materials has resulted in reduced liabilities with the shipments of remote-handled transuranic materials to the Idaho Nuclear Technology and Engineering Center (INTEC). Retrieval activities were well coordinated with the cleanup contractor to develop and obtain approval of the transportation plan that provided the nuclear safety basis for both transport from MFC to INTEC and open-air transfer of the waste containers at the Radioactive Scrap and Waste Facility.

4.2 Resource Commitments

The DOE RFP that resulted in the current BEA contract invited proposers to identify collaborative partners to provide resources to support the development of INL into the pre-eminent nuclear research laboratory and stimulate the anticipated "renaissance" of nuclear power. The BEA team, along with a roster of corporate, state, and university stakeholders, responded with a proposed portfolio of 27 commitments⁶ comprising \$62 million in "direct" investments, \$106 million in new RDD&D "program" funding, and preferential "access" to \$1.1 billion worth of nuclear facilities and intellectual property relevant to specific anticipated research thrusts. DOE incorporated the entire proposed portfolio into the BEA contract with fulfillment of the commitments expected during the ten-year base contract. While these resources collectively represent an obvious leap forward in INL's institutional development, perhaps more importantly, they were intended to underpin long-term INL relationships with the various

6. Since 2005, this number has been revised to 28 commitments.

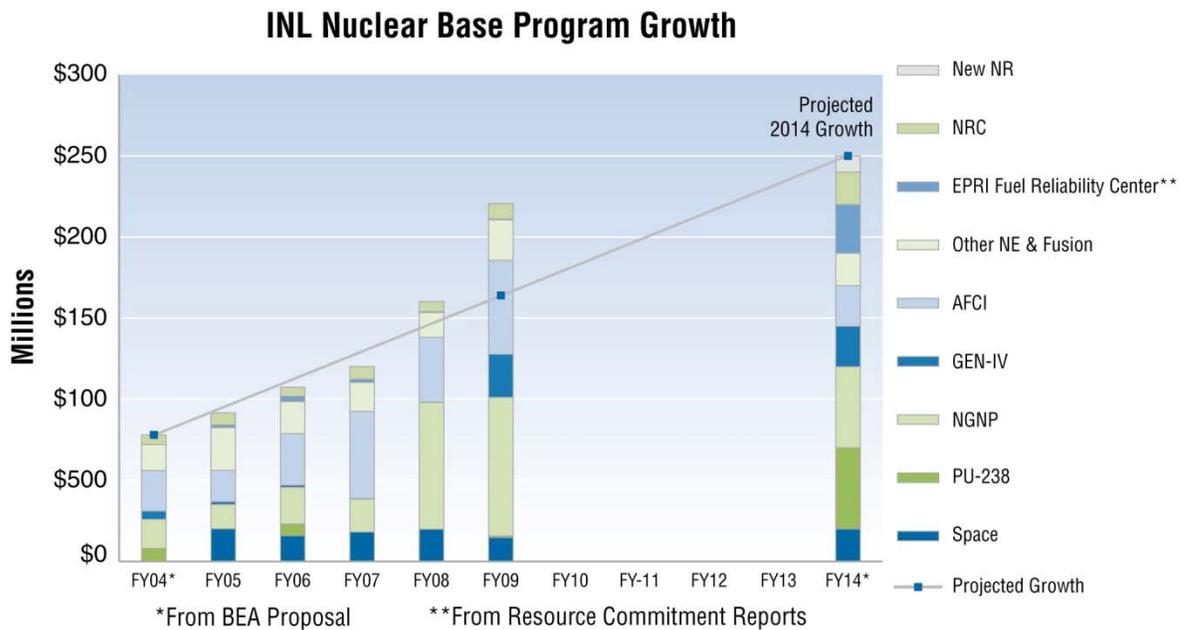
parties. During the first five years of the contract, BEA has developed numerous other collaborative relationships that are contributing to mission accomplishment.

The “direct” investments are cash or in-kind and are directed to, among other things, INL facility upgrades, equipment donations, and support for education programs. The “program” commitments call for various parties to provide or facilitate actions by others to increase INL RDD&D program funding. The “access” commitments make available to INL a variety of costly, unique facilities and research products, substantially extending INL’s research capabilities at little or no cost to the government. At the five-year mark, the results, as with any portfolio, are mixed: some commitments have been fulfilled exactly as foreseen, goals in some of them have been substantially exceeded, and others have not performed as envisioned:

- CAES has become a reality and has exceeded original expectations both in direct contributions and in impacts. As envisioned, CAES has become a forum for greatly expanded interactions among INL and the Idaho research universities. In addition, it is supporting DOE headquarters by managing the Nuclear Energy University Programs, and has hosted numerous educational events for K-12 students and academic researchers alike. Growth of the research portfolio has substantially exceeded original expectations with CAES research teams securing more than \$13M in research funding during FY–09. CAES has also contributed to a rebirth of nuclear engineering programs at Idaho universities—nuclear related degree programs that had fewer than two dozen students five years ago, today count 250 degree candidates. Built on land provided by the Idaho State University (ISU) Foundation, CAES was funded with “direct” resource commitments from the State of Idaho and BEA team members Battelle and URS. Despite a historically austere budget environment, the State of Idaho has provided support well above the original commitment and CAES has received significant equipment donations from the private sector in addition to solid support from DOE. A second facility employing the CAES business model for collaboration is in the planning stages.
- INL credibility and leadership in nuclear research depend in part on the state of its research facilities and equipment. Addressing years of deferred upgrades and maintenance, BEA has plowed back nearly \$20M in earned fee to upgrade and build new capabilities for ATR. Most prominent among the improvements is the design and installation of a pneumatic shuttle device that allows target materials to be moved into and out of the reactor independent of reactor operating schedules. This capability is important for researchers, but also creates flexibilities needed for isotope production.
- BEA has leveraged the capabilities of INL facilities with access arrangements for various unique university and corporate nuclear facilities under resource commitments. In addition to the \$1.1 billion worth of corporate and university facilities made available under these resource commitments, the ATR NSUF program has added research facilities at the University of Wisconsin, University of Michigan, University of Nevada—Las Vegas, and the Illinois Institute of Technology to the list of experimental facilities accessible by INL. While the relationships and technical interactions among INL and the resource providers have grown, facility access has not figured as prominently as originally envisioned. Many of the access agreements have been in place since early in the contract, but utilization of those facilities to date has been scant. Facility usage is a function of program needs, which to date have not included extensive experimental programs requiring use of those facilities. BEA management and research staff understand the breadth of capabilities these facilities represent and will continue to use them as program opportunities warrant.
- BEA has provided over \$5 million of direct funding to support numerous education-related initiatives. The initiatives funded in Idaho have a heavy emphasis on STEM education and improvement to resources available to teachers. This funding has been used for, among other things, training for several hundred K-12 STEM faculty, equipment upgrades to dozens of Idaho public schools, and participation of Idaho high school teams in international robotics competitions. This funding also

enabled the establishment of IRON through which Idaho university faculty can collaborate nationwide over the Lambda Rail, the nation’s internet backbone providing shared access to super computing resources. In addition, some of this funding has been used to endow a nuclear engineering faculty position at the Massachusetts Institute of Technology.

- Nuclear research program growth at INL has substantially exceeded projections made at the time of the proposal. The BEA proposal put forward an ambitious target of more than tripling INL’s nuclear base programs within ten years; FY–09 numbers indicate that 80% of the ten year growth target was achieved in the first five years. This success reflects enhanced staff capabilities, facility improvements funded through corporate resource commitments and Federal investments, and strong DOE and Congressional support. The desired involvement of private sector players as programmatic funding partners has, however, been limited due to several factors: unrealized approval of PFTT and use permit contract mechanisms, state restrictions on INL acceptance of research quantities of used nuclear fuel limit post-irradiation examination (PIE) activity; unmet EPRI preconditions regarding commercially acceptable business and intellectual property terms (use permit) continue to stand in the way of their proposed funding; and the corporate standing of two of the original resource committers is fundamentally changed (BNFL no longer exists; Westinghouse is now a subsidiary of Toshiba). Recognizing the importance of the private sector as partners in and ultimate users of INL research products, finding ways to increase commercial involvement as program sponsors continues to be a priority for BEA management.



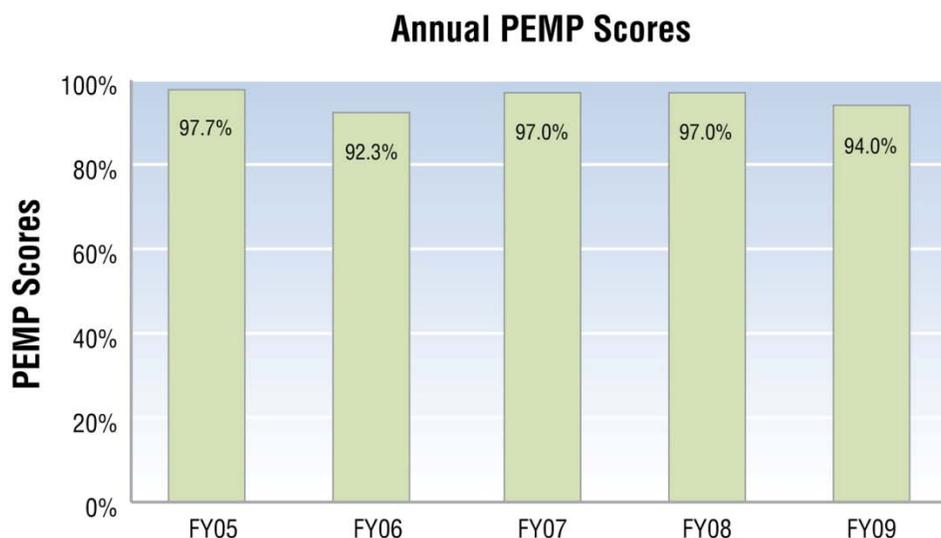
INL, DOE, the State of Idaho, and other collaborative partners have benefitted greatly from the totality of resources committed to date. As with any portfolio, some of the contractual resource commitments have exceeded expectations and some have performed exactly as planned; others, particularly under the “program” heading, have performed far below expectations. Going forward, BEA is assessing the portfolio of resource commitments with the intent of continuing to nurture the relationships that have proven beneficial to INL’s institutional development and growth. BEA will develop and formalize other

means of involving collaborative partners in INL RDD&D activities. Having a practical, substantial, demonstrable impact on the commercial deployment of nuclear power has always been a primary driver for BEA; successful partnerships are essential to achieving that outcome.

4.3 Performance Evaluation and Measurement Plan (PEMP)

DOE's evaluation of BEA performance as measured by each fiscal year's PEMP indicates that BEA has consistently achieved and in most instances exceeded expectations, most notably in the mission areas.

Achievement of mission-focused objectives and measures was consistently rated very high (A- or better). Evaluations repeatedly document DOE's high level of satisfaction with BEA's performance toward advancing nuclear energy RDD&D through strong strategic leadership and technical performance. In addition, BEA was consistently recognized for achieving objectives and measures relative to building technical capabilities and providing strong leadership capability, particularly toward achieving ISMS verification and excellence in operations.



Although past PEMP evaluations have noted DOE concerns with some areas of operations (laser event in 2005, electrical safety concerns in 2006, fume hood fire and wildland fire electrical shock events in 2007, and security incidents in 2009), in all cases of noted deficiency, BEA has implemented corrective actions and applied the necessary management attention to address the concern and improve performance. One area that remains a concern is the management of projects—BEA has deployed effective system tools/practices, but has not effectively achieved consistency in deployment and results.

5.0 Strategic Risks

Although this report has generally concluded that BEA's progress toward achievement of the INL Ten-Year Vision has exceeded expectations at the mid-point of the ten year period and that BEA is expected to continue to do so over the next five years, there are a number of areas that present strategic risks to success. This section of the report draws attention to those areas:

- **Idaho Settlement Agreement**—the Agreement's impact on INL's role in disposition of commercial used fuel
- **Execution of TYSP**—implementation of (including funding for) key facility acquisitions/upgrades to build/upgrade Laboratory core capabilities

- **Human Capital (Attraction and Retention of Talent)**—ability to meet human capital demands (skills and experience)
- **Consolidation of Nuclear Materials**—maintaining as an asset, a cost effective capability to handle and store a diverse inventory of nuclear materials
- **Role of Commercial Work**—ability to do nuclear RDD&D with commercial entities in balance with NRC conflict of interest restrictions (honest broker)
- **Relevance and Impact of Science and Engineering**—address role of applied energy laboratories (e.g., technical integration) and scaling of innovation: deployment and funding for large commercial demonstrations of energy technologies (e.g., Small Modular Reactors and NGNP)
- **Project Execution**—build credibility to deliver projects (large and small; simple and complex) within cost, schedule, and technical scope
- **Ability to Learn**—build a credible Contractor Assurance System that effectively and transparently identifies and resolves issues.

6.0 Summary

BEA has made major progress to deliver on the INL Ten-Year Vision.

- BEA is implementing a strategy that is well-synchronized with the DOE strategy, a strategy that INL helped lead and socialize with key stakeholders
- Research results demonstrated and research integrated among labs and universities (peer reviews continue to confirm technical excellence)
- Steadily increasing nuclear science and technology base budgets supported by growing, synergistic national and homeland security, energy, and environmental portfolios
- Partnerships of strategic importance (EPRI, CAMS, Energy Frontier Research Center, Modeling and Simulation Hub, etc.)
- A solid partnership with industry on LWR-S is a launching pad for relevant industry engagement
- Significantly enhanced university engagement through CAES, NEUP, INEST, and NSUF
- Investment vision and strategy established that links to mission needs, supporting infrastructure stabilized, new advanced tools and instruments, new facilities, and capabilities
- Strategic importance of the NSUF—prototyping the lab of the future, attracting the best and brightest, as well as the best facilities for the research.

BEA is transforming INL to serve as DOE’s nuclear energy lead laboratory, managing a “virtual” nuclear energy capability set (including other labs, universities, and industry) instead of physical consolidation of nuclear energy expertise in Idaho. Concurrently, BEA is building a National Laboratory with the physical infrastructure and inherent strengths that best meet the needs of the nation, incorporating capabilities into the nuclear energy program wherever they exist and building all new nuclear facilities requiring relative isolation and high security at INL. In the next five years, BEA must focus on efficient and effective performance, delivering results, and demonstrating value to the nuclear research community.