
A STRATEGIC ALLIANCE BETWEEN REGIONAL UNIVERSITIES AND INDUSTRY AT A NATIONAL LABORATORY

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Introduction

This paper presents a unique partnership between academia, industry, and government to manage and operate the multi-purpose Idaho National Engineering and Environmental Laboratory (INEEL) for the United States Department of Energy (DOE). This partnership provides novel opportunities and strengths in research and education for laboratory staff, university faculty, and students.

This paper describes the novel structure in which collaboration between the regional universities and the INEEL delivers graduate degree programs and continuing education courses to support the laboratory's research and development (R&D) missions. Research and development activities and innovative educational programs and collaborations in both research and instructional activities are detailed. Examples of collaboration include joint proposals for scientific and engineering research and joint supervisory committees for doctoral and masters degrees offered to students at INEEL and on the university campuses by the various institutions. Structures are presented for delivering advanced science and engineering degrees on location at INEEL, and for distance education initiating at INEEL or at one of the participating universities.

The alliance strengthens the research culture at the laboratory and universities by creating *virtual faculties* and departments consisting of qualified laboratory staff and university professors in areas of mutual interest at distributed locations within the region. It provides the opportunity to create nationally competitive research groups with both breadth and depth at minimal cost, and encourages the use of the Internet and video-conferencing for collaboration in research and in educational programs.

The Alliance

In 1999, seven universities in the northwestern United States formed the Inland Northwest Research Alliance (INRA). An eighth university joined the partnership in 2001. Together with Bechtel and BWX Technologies, a dynamic partnership was formed that successfully competed for the government contract to manage and operate the INEEL.

INRA is a partnership between the following eight regional universities:

1. Boise State University in Boise, ID
2. Idaho State University in Pocatello, ID
3. Montana State University in Bozeman, MT
4. University of Alaska Fairbanks in Fairbanks, AK
5. University of Idaho in Moscow, ID
6. University of Montana in Missoula, MT, including Montana Tech in Butte, MT
7. Utah State University in Logan, UT, and
8. Washington State University in Pullman, WA

Each university brings unique strengths and resources to the alliance. For example, the Center for Biofilm Engineering at Montana State University provides expertise on bacteria growth in the subsurface, an area of specific interest for environmental cleanup at the INEEL. A mission of the alliance and its industrial partners focuses on strengthening research and educational programs serving the INEEL. A major goal of INRA is to maximize the performance of Bechtel BWXT Idaho (BBWI) as a DOE contractor. The locations of the INRA universities are shown in Figure 1, along with INEEL and the Pacific Northwest National Laboratory (PNNL) in Richland, Washington. The INEEL and many of the INRA universities have cooperative research and educational relationships with PNNL.

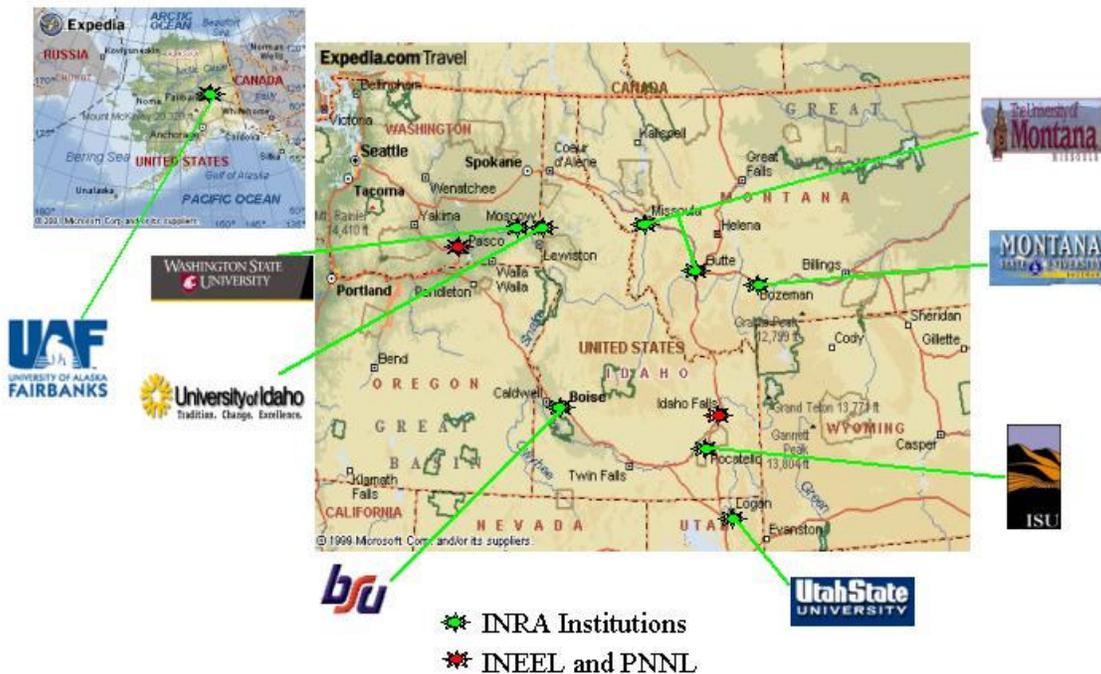


Figure 1. The universities forming the Inland Northwest Regional Alliance (INRA)

INRA is a non-profit corporation with 10 percent interest in BBWI and shares responsibility for managing and operating the INEEL. BBWI management reports to a Board of Members comprised of senior managers from the partners, including INRA. INRA shares in any fee for performance generated, up to \$2M each year, and is committed to reinvesting at least half of its share of the fee into research programs of strategic interest to both the INRA universities and INEEL. Two experienced university administrators currently serve as senior managers at INEEL. INRA is managed by an Executive Director whose office is located in Idaho Falls. The Executive Director reports to INRA's Board of Trustees, which consists of the Presidents of INRA's member universities. Additional information is available online at www.inra.org.

While the partnership of INRA and INEEL is young and ambitious, all involved recognize the potential for this model to provide long-term stability and vitality for future generations. The rights and responsibilities of each university in the Alliance and the corresponding obligations of INEEL are still being defined. The relationship of being a part owner of a limited liability company and functioning as a separate contractor to INRA and/or INEEL for specific services has legal implications that are sometimes difficult to define; intellectual property issues for example.

The INEEL

The INEEL is a multi-program national laboratory with a significant environmental cleanup mission. Understanding the nature of the INEEL is important in setting the stage for explaining the strategic elements of the Alliance. The major business lines of the INEEL are environmental quality, energy resources, science and technology, and national security. As the first "E" in the name implies, the INEEL has established a national reputation as a place for *engineering* demonstrations and deployments. The second "E" responds to the current mission of DOE in *environmental* management, and supports the future stewardship of sites, which must be monitored and protected in the interest of public safety for many years to come.

During its 50+-year history, there have been several contractors at INEEL; the current contract with BBWI is the first to include universities in the management responsibility, recognition by DOE of the need for cooperation with regional institutions and for participating in the economic development of the state and region.

The INEEL has a variety of major facilities in Idaho Falls and at remote site locations. Research laboratories, such as the INEEL Research Center, and administration buildings are located in Idaho Falls. Major remote site facilities, illustrated in Figure 2, support operations and R&D in hazardous waste treatment and storage, nuclear technologies, and larger scale engineering projects. Many of the facilities are one-of-a-kind and therefore, provide unique opportunities for research, development, and education for the alliance partners.

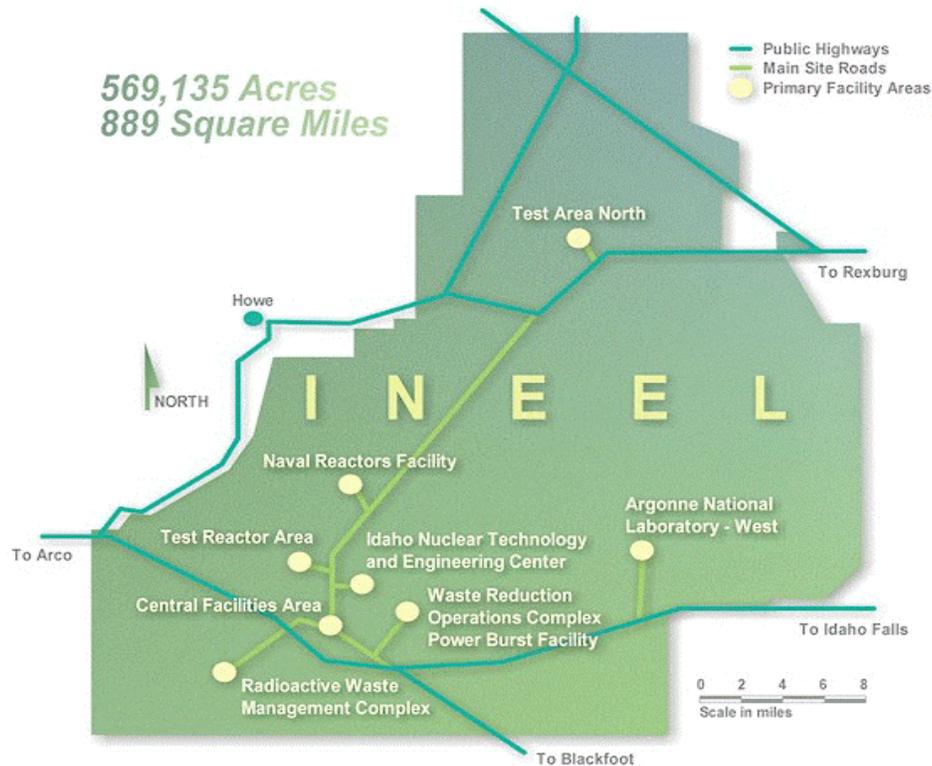


Figure 2. The Idaho National Engineering and Environmental Laboratory (INEEL)

Since being established in 1949, the INEEL has played a critical national role in the research and development of nuclear technologies, energy and materials, biotechnology, renewable energy, and national security. The beginnings of the INEEL as a demonstration and testing site for nuclear power systems, together with waste from other locations, created the need for both cleanup at specific locations and for managing waste repositories.

Integrated Research and Education

A core mission of the INEEL is R&D in subsurface science technologies necessary to prevent ground water contamination. Such R&D encompasses a spectrum of talents of scientific disciplines, including geology, hydrology, chemistry, microbiology and their combinations.

The initial thrust of INRA's collaborative activities was focused on enhancing the research capabilities and educational opportunities in the area of subsurface science.

Part of INRA's investment is a novel program to support research in subsurface science. At this time, 19 doctoral students and post-doctoral researchers are performing research in areas specific to subsurface science. Additional students and post-doctoral fellows will be added to the program as funding permits. Each student and post-doctoral researcher is affiliated with an INRA university and teamed with an INEEL research mentor. The students and faculty conduct their research at the respective university campuses and at the INEEL. This successful

collaborative program will be expanded to include research projects in broader areas of environmental management, energy sciences, and national security.

Laboratory scientists and engineers, together with university faculty and students, provide the foundation for integrating R&D and education at the INEEL.

A Virtual Faculty

The concept of a *virtual faculty* depends on several elements of cooperation. The organization of such a faculty is incidental to its function and does not interfere with any current management structures at either the laboratory or at the universities. Three needs must be met for successful cooperation.

First, there must be a need for both education programs and research in an area of mutual interest to the laboratory and two or more universities within the Alliance. This subject area is likely to be one of national priority and one for which significant financial support for all participants is possible. In the case of INEEL and INRA, the need for increased knowledge in subsurface science includes the fields of geosciences, chemistry, biology, and related engineering sciences, and the coupling of processes involving these areas in the soil and in water. Modeling of the transport of contaminants in the subsurface and prediction of their fate contributes to a scientific “grand challenge” in environmental management that was posed by the DOE to INEEL. Although we have selected this area as an example, the philosophy and structure of this program are easily transferred to any area of research that includes science, engineering, technology transfer, and deployment.

Second, the participants must exhibit both passion and excellence in the fields of study required by the grand challenge. A prerequisite for success in such a venture is a common interest centered on a challenging problem with elements of science and engineering that must be solved in the national interest. Also required are the associated potential for funding over a fairly long period and substantial interest by the public in solving the grand challenge. Both university faculty and laboratory staff must be committed to achieving world-class reputations, individually and collectively, and the qualifications of those involved must be commensurate with that goal.

Third, there must be a recognized facility or group of facilities to support the anticipated work by both students and faculty. Experience has shown that productive and profitable collaborations between universities, industries, and the private sector are most successful in a campus-like environment where multidisciplinary colleagues collectively participate in professional research, development, and education. In our case, two new facilities are planned that will support subsurface science initiatives: the Center for Science and Technology (CST) and the Subsurface Geosciences Laboratory (SGL). The CST facility is a research building owned by the State of Idaho and will be located adjacent to the local branch campus of the University of Idaho and Idaho State University. The CST is expected to open in 2003 with approximately 50,000 square feet next door to the INEEL. The universities are building it with fiscal support from federal, state, city, and university entities. The SGL is planned for 2007 as the major INEEL research facility to support subsurface science research. The SGL will be co-located with the CST near the current university branch campus and the INEEL in Idaho Falls.

In addition to the critical elements listed above, the requirements include strong and enlightened encouragement of collaborative programs between INRA and INEEL and a willingness to invest and make resources available to support the venture, particularly in the early phases. The development of a sustained production of research results and academic program graduates (mostly PhDs) will take between five and seven years after all involved are fully engaged. The return on investment for the venture depends on a substantial investment and effort. The healthy skepticism that always accompanies a venture of this kind abounds in our current climate.

The beginnings of a *virtual faculty* can occur serendipitously or by direct leadership. We began by asking all interested faculty and staff in chemistry, biology, geology, engineering, and related sciences of subsurface processes to meet to define the “grand challenge.” The objective was to cause new relationships to form among individuals with common and related interests, and to foster cross-disciplinary inquiry among scientists and engineers with specific capabilities. The commitment and sustainable interest of management at INEEL was well-established because subsurface science has been designated the signature capability of INEEL and has been academically endorsed by the universities.

In response to these beginnings, a collection of university faculty and INEEL researchers has formed the nucleus of a subsurface science *virtual faculty*. Working in different locations, the faculty communicates remotely through the Internet, through interactive compressed video, and by conventional means. The INEEL and each university have invested in the equipment and infrastructure necessary to make real-time distant communication possible.

INRA is engaging the expertise of the *virtual faculty* members in subsurface science in a new, federally-funded initiative to develop a multidisciplinary PhD program in subsurface science. This Subsurface Science Graduate Program (SSGP) is the primary educational component of INRA’s program to support subsurface science research in the Inland Northwest and will complement the ongoing INRA-funded collaborative research projects in subsurface science. The SSGP will be based on disciplinary or interdisciplinary PhD “host programs” selected by the INRA graduate deans from the set of programs that can host a subsurface science dissertation.

The Students

The most important element of any educational program is the students. Students who participate in the Subsurface Science Graduate Program (SSGP) generally pursue traditional science or engineering degrees in the participating universities. The students in our program have varied backgrounds. Many are “traditional” graduate students on the participating university campuses and others are laboratory staff with some experience in INEEL programs.

A student who wishes to participate in the SSGP must be admitted to both a host program and the SSGP and is subject to the requirements of both programs. The multi-disciplinary curriculum for this doctoral program is now being developed. Courses will be offered and shared by all INRA universities and the INEEL through state-of-the-art distance delivery methods. Students will be asked to achieve a breadth and depth of understanding in the fields comprising subsurface science that is beyond the background required for many of the existing disciplinary doctoral programs at the INRA universities. As a result, students who complete the

curriculum should be better prepared to undertake interdisciplinary research on subsurface processes and the numerous applications in which those processes play a role.

The completion of a PhD degree in a traditional area delays the obsolescence of a degree named for a currently popular scientific technical field. Examples of such degrees that have had mixed histories over the past few years are aerospace engineering, nuclear engineering, and environmental science. These degrees will continue to suffer the effects of increasing and decreasing student numbers and funding as the public perception of the value of each field changes. By participating in a recognized, traditional degree program with a dissertation topic related to subsurface science, the student builds a more flexible credential than a doctoral degree in subsurface science. This flexibility is important in the current employment environment where graduates may expect to have several employers and several different positions during their careers.

The self-interest of the laboratory is represented in the growth of scientific and technical capability for laboratory staff and a source of new employees educated in a relevant discipline for future research and development. The interest of the universities is covered by an increase in PhD production and by an increase in research productivity by faculty. Both the laboratory and the universities benefit from joint research programs that meet DOE mission requirements. Unique equipment and personnel can be shared as appropriate to support research in the various locations.

Special Programs

Several special programs have been established to help support the partnered research and education activities. To the authors' knowledge, the programs are unique.

The INEEL-INRA Post-Graduate and Foreign Visitor Program: The INEEL contracts with INRA to help facilitate post-graduate fellows (with emphasis on post-doctoral fellows) and foreign visitors working at the INEEL. Post-doctoral fellows become employees (research associates) of Washington State University (WSU), with typical faculty benefits and privileges, working at the INEEL. Post-doctoral candidates are identified by INEEL researchers, by INRA faculty members or through the WSU on-line recruitment/application site: www.asp.wsu.edu/ineel.htm. This program was established in Spring 2001 and is expected to facilitate the employment of approximately 30 post-doctoral fellows during the first two years. The program provides a full range of services for post-graduates and foreign visitors including payroll, relocation, visas, taxes, medical and retirement benefits.

The INRA Faculty Sabbatical Leave and Summer Programs: INRA provides its faculty members with a \$1250 per month stipend while on sabbatical leave at the INEEL. This enhancement is also available to faculty who spend their summers working at the INEEL.

Matching Funds for Competitive Proposals: INRA competitively awards up to 10% in matching funds for grants that involve at least two INRA universities on research proposals for \$500,000 or more.

Advanced Degree Opportunities: Universities provide a spectrum of advanced degree opportunities locally for employees of the INEEL. Over twenty different graduate degree programs in science and engineering are locally available. Typically, about 600 laboratory employees are taking university classes and working toward an advanced degree or taking classes as part of their professional development program.

Classes are provided locally through several delivery mechanisms including live instruction, interactive video, videotape and web-based instruction. Many of the instructors are adjunct faculty from the INEEL.

Technical Short Courses and Workshops: Various technical short courses and workshops are hosted at the INEEL as part of our professional development program. Subject matter experts, including faculty from the INRA universities, provide instruction.

Concluding Remarks

We are optimistic that in 15 years there will be several joint INRA/INEEL centers and institutes performing world-class research in science and engineering focused on environmental and energy issues important to the northwest region and the nation. The centers and institutes are expected to attract increasing participation by private industry and state and local governments. Such centers and institutes may be located in Idaho Falls, on university campuses, or at university or private research parks, as appropriate. We expect that in the near future we will add emphasis on technology transfer and commercialization and economic development to our cooperative agenda.

As with any joint venture, there is an expectation that all partners will invest significantly in the future of INEEL and its relationship with INRA. We expect that as the programs mature there will be about 100 post-doctoral fellows on campus and at the laboratory on a continuing basis and at least ten faculty and staff exchanges each year. Research and education are complementary interests of the INEEL and the INRA universities. Long-term success of the venture will be measured by enhanced research productivity and the successful integration of academia, industry, and government at the national laboratory.

We see our work as a strong beginning to a concept that is bounded only by our willingness to take reasonable risks and invest in the future of research, development, and education for the public good. The examples of *virtual faculty*, dedicated research facilities and special programs are cost-effective ways to create a world-class capability revolving around a national laboratory's mission to solve real-world problems defined by our stakeholders. The experience for science and engineering students will be unequalled as the relationship matures.

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Biographical Information

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Dr. Gunnerson is a professor of engineering with the University of Idaho, seconded to the INEEL where he serves as Director of Education and Research Initiatives. He has over 22 years of university and national laboratory experience. His current responsibilities include advanced education and professional development of laboratory personnel, statewide K-12 programs, and direction of the INEEL Technical Library. He holds MS and PhD degrees in nuclear engineering from the University of New Mexico and a BS degree in mechanical engineering from Colorado State University.

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Dr. Jacobsen is Associate Laboratory Director for Strategic Management and Chief Scientist at the INEEL. He previously served nine years as Dean of Engineering and Director of the Center for Applied Thermodynamic Studies at the University of Idaho in Moscow, ID. Dr. Jacobsen is a former Vice President for Professional Practice and current chair of the Committee on Thermophysical Properties in the Heat Transfer Division of the American Society of Mechanical Engineers. He holds BS and MS degrees in mechanical engineering from the University of Idaho and a PhD in engineering science from Washington State University.

GAUTAM PILLAY:

Dr. Pillay is the Executive Director of INRA. He has the responsibility for carrying out the goals of the alliance, including developing and implementing strategic plans, developing business opportunities, and monitoring contract and fiscal performance. He serves as INRA's on-site point-of-contact in the management of the INEEL, in which INRA is a partner with Bechtel and BWXT. He has 18 years of experience at U.S. Department of Energy national laboratories, most recently as a senior manager at the Los Alamos National Laboratory. He holds a PhD in chemical engineering from Texas A&M University.