Education & Workforce Subcommittee

FINAL REPORT & RECOMMENDATIONS

October 23, 2012

Chairman: Dr. Duane Nellis

Members: Ben Baker, Dr. Harold Blackman, Richard Holman, Rep. Jeff Thompson, Roger Madsen, Dr. Robert Smith

Staff: Gordon Graff, Will Jenson

Purpose

The Education and Workforce Development subcommittee examined the state's efforts to develop nuclear energy capacity in the following six areas, which comprise the charge given to the subcommittee by the LINE Commission, and developed key findings as summarized below:

1. Identify Idaho's current strengths and deficiencies in the quality, availability and quantity of the necessary skilled workforce to support the INL and its role in nuclear energy.
   Key Finding: At the current rate of degree production, Idaho universities and technical colleges will not be able to meet the workforce needs of the INL and associated industries in the future; this shortfall is especially pronounced at the doctoral and master's level.
2. Summarize the challenges related to age of existing nuclear workers and impending retirements in both civilian and defense related nuclear establishments.
   Key Finding: A shortage of replacement workers to meet future demand exists as large numbers of current retirement age employees leave the workforce. There is also a need to develop strategies to address the potential knowledge loss as these retirements occur.
3. Summarize the ability of domestic educational programs to produce qualified graduates and review any opportunities and/or requirements associated with expanding the number of foreign workers as part of the nuclear workforce.
   Key Finding: Nationally, growth has occurred over the last several years in the production of new nuclear technician and engineering graduates. Idaho higher education institutions represent a small fraction of these totals. Security restrictions limit the ability to employ foreign workers at nuclear facilities, but opportunities exist for regional collaborations to further public-private involvement in nuclear energy education/workforce development.
4. Summarize how Idaho's programs/institutions compare to other state and federal education programs or institutions that address workforce training for the nuclear industry.
   Key Finding: The quality of Idaho's nuclear programs/institutions is comparable to other states as demonstrated by the high degree of success in federally funded peer reviewed nuclear energy research programs.
5. Recommend steps that need to be undertaken to correct any deficiencies or opportunities that may exist to strengthen Idaho's competitiveness in developing workforce solutions for the industry.
   See the Recommendations section below.
6. Outline opportunities for the INL to enhance the development of new nuclear technologies in conjunction with Idaho's universities.
   Key Finding: The activities described in the Recommendations section will only be accomplished with the active participation and collaborative involvement of INL management, Idaho Department of Labor, Idaho Department of Commerce, Idaho Department of Education, the Office of Professional Technical Education and Idaho's universities and technical colleges.

Compiling research from a variety of local, regional and national sources, the subcommittee members identified areas of opportunity and potential growth. The following section contains recommendations for acting on these findings. Subsequent pages and appendices provide supporting material for the following recommendations.

Recommendations

Building on existing strengths of collaborative programs involving the state's three research universities and multiple technical colleges, appropriate $5 million from the General Fund to expand the reach and scope of Idaho's STEM channels for nuclear energy education and workforce development. The funding will be used, in coordination with the Higher Education Research Council (HERC) and the Council on Academic Affairs and Programs (CAAP), to develop an organized system for ongoing advancement of the industry-education-workforce interface. This will lead to improvements in nuclear workforce cultivation, education and availability in the face of impending retirements; additional faculty fellowships, university and technical college student internships and scholarships; additional, relevant post-secondary coursework and infrastructure; productive engagement with regional nuclear business and industry; and the integration of existing learning opportunities for K-12 teachers and students with the goal of improved focus on nuclear energy occupations. Recommended avenues for accomplishing this include:

1. Using the Center for Advanced Energy Studies as a focal point for information and action, evaluate methods and implement approaches to: 1) best inform state policy makers and agencies on energy issues including nuclear; 2) share nuclear best practices, lessons learned and related data with industry, industry support organizations and government entities; and 3) explore/create, in conjunction with the state's universities and technical colleges, the need for additional science, engineering and technology degree programs, unique staffing and/or associated equipment. Within this context, the following activities are recommended:
    a. Develop and implement a sustainable funding model for the Nuclear Operations/Engineering Technology Associate in Applied Science Degree Program at Idaho State University's Energy Systems Technology and Education Center (ESTEC) and support the upgrade of the two remaining ESTEC energy technician programs (Electrical and Mechanical Engineering Technology) to national Nuclear Uniform Curriculum Program standards.
    b. Assess the facilities, instrumentation, equipment and other infrastructure currently available to support nuclear science, engineering and technology programs at Idaho's universities and technical schools and develop and implement an upgrade plan that will facilitate world class undergraduate and graduate education.
    c. Assess the long-term feasibility of establishing the "Idaho Polytechnic Institute," a statewide educational collaboration between Idaho's universities and its community and technical colleges with the goal of providing applied science and technology degree options at all levels. This non-degree-granting institute would provide a focus for the integration of engineering and technology coursework in an effort to provide market-sector focused degree programs and research.
    d. In cooperation with organizations such as the International Atomic Energy Agency and the World Association of Nuclear Operators, determine the role of Idaho's two- and four-year institutions in providing nuclear curriculum and instructional expertise to emerging nuclear power countries.
2. Establish an industry-driven Nuclear Talent Task Force as a singular focal point for defining and resolving workforce issues and challenges unique to the rigor, discipline and

requirements of Idaho's nuclear research, development and operations community. (See Appendix A for details.)

3. Leverage and systematically integrate existing K-12 and STEM education initiatives throughout the state with efforts described in the above recommendations to improve post-secondary nuclear science, engineering and technology education and the readiness of students to enter these programs.

Supporting Information

1. Identify Idaho's current strengths and deficiencies in the quality, availability and quantity of the necessary skilled workforce to support the INL and its role in nuclear energy.

A key factor influencing the growth and success of nuclear related industries in Idaho is the availability of a well-educated work force. A simplistic[1] comparison of educational attainment in Idaho compared to expected hiring needs is presented here. Based on an employee head count and attrition rates report provided to the commission by the INL[2]; the INL has hired, on average, approximately 329 new people per year (attrition of 206 plus growth of 123) between 2006 and 2011. During this period of time the INL grew from an employee head count of 3,513 to 4,181. The distribution of the highest degree of educational attainment for these hires was 21 percent high school, 14 percent associate's or post-secondary certificates, 32 percent bachelor's, 17 percent master's and 17 percent doctor's degrees.

During the same time period, from 2006 through 2011, Idaho universities graduated an annual average[3] of 299 bachelor's, 64 master's, and 12 doctor's degrees in disciplines[4] relevant to nuclear science and engineering. Of the total[5] degrees awarded, 51 percent were in mechanical engineering and 3 percent in nuclear engineering.

At present, increased concerns regarding the federal budget deficit and uncertainty in budgeting approaches to deal with the deficits make accurate long-term projections of hiring needs difficult. It is unlikely that 2013 will be a growth year for the INL. While INL nuclear activities may remain somewhat stable, other INL programs are going to be adversely affected based on federal budget cuts to a host of agencies that INL supports. The 2014 budget may represent a return to 2012 funding levels. The U.S. Department of Energy's Office of Nuclear Energy (DOE-NE) recognizes the need to preserve and further develop the infrastructure for fuels research and will

[1] If formed per the subcommittee recommendation, the Idaho Nuclear Talent Task Force should be charged with conducting and maintaining a more sophisticated and detailed analysis of nuclear employment needs and work force availability under the Idaho Workforce Development Council and Idaho Department of Labor.

[2] INL Workforce Profile. See Appendix B.

[3] Integrated Postsecondary Education Data System (IPEDS) http://nces.ed.gov/ipeds/datacenter/

[4] Disciplines considered include: Applied Mathematics, Chemistry, Chemical Engineering, Engineering Physics, Materials Science and Engineering, Mechanical Engineering, Nuclear Engineering, and Physics. Although important to the nuclear industry as well as a wide variety of other industry sectors, Computer Science, Computer Engineering, and Electrical Engineering are not included in the totals.

[5] The total degree distribution (AAS, BS, MS, Ph.D.) conferred in the subject areas by higher education institutions was 17 percent Boise State University, 20 percent Brigham Young University-Idaho, 15 percent Idaho State University, 44 percent University of Idaho, and 4 percent combined for Lewis-Clark State College, Northwest Nazarene University and College of Idaho.

be looking to advance the TREAT Reactor restoration, the Remote-Handled Low Level Waste Cells and the new Post-Irradiation Examination Facility. In addition, based on the recommendations of the Blue Ribbon Commission, there are potential opportunities in Interim Storage and the associated research required for high burnup fuels storage. Dry cask storage for lower level fuels is available but more research is needed to accommodate high burnup fuels. INL has the facilities to conduct this research. The budget for these interim storage activities may be separated from existing Fuel Cycle Research and may see substantial increases. In light of the high degree of uncertainty, three planning scenarios projecting future work force needs were considered and are presented below:

Scenario 1) Sustaining the INL with no regional growth in the nuclear industry – in this scenario attrition is assumed to be the only source of new opportunity at a rate of 6 percent per year (240). It is further assumed that the distribution of educational attainment will be the same as described above.

Scenario 2) INL growth in select programs (logical areas include Fuels Research, Light Water Reactor Sustainability, Infrastructure and Operations) with no regional growth in the nuclear industry – in this scenario it is assumed that the sources of new opportunity will include attrition of 6 percent (240) and growth of 3 percent (120).

Scenario 3) INL growth in programs and regional growth in private-sector nuclear business - in this scenario it is assumed that INL employment demands (360) will be as described for Scenario 2 and that the needs of private companies will be 15 percent (54). Additionally, it is assumed that the private sector hiring will not generate additional demand for employees with PhD degrees.

The annual employment needs from these projected scenarios, as well as the historic average degree production by Idaho's universities, are summarized in Table 1 below.

Table 1: Comparison of INL Employment Scenarios with Number of Higher Education Degrees Awarded

	Total	High School	Associate	Bachelor	Master	Doctor
Scenario 1	240	50	33	76	40	41
Scenario 2	360	75	49	115	60	61
Scenario 3	414	89	58	135	71	61
Idaho Universities				299	64	12
Available Graduates*			30**	235	52	12

*Because some fraction of graduating students at both the bachelor's and master's level go on to obtain the next degree level, the number of bachelor's and master's available for employment have been reduced by the number of degrees awarded at the next level. This represents the maximum available for employment in each category.

**Assumes that the ESTEC Nuclear Operations Program and Nuclear Instrumentation and Control programs receive sustained funding.

Examination of the table suggests that, at present, the hiring needs of the INL and associated nuclear-related industries require a significant number of the total annual bachelor's level graduates. However, Idaho universities fall well short of meeting the needs of the INL and associated industries in terms of the number of graduate degrees. In addition, the need for nuclear or nuclear-related education at the technician level (two-year associates in applied science and one-year certificate programs) will closely track the need for other degrees. Currently in the region, there are only three nuclear/radiological technical programs to address the INL's specific nuclear or radiological technician workforce needs. These include the Nuclear Operations Engineering Technology and Nuclear Instrumentation and Control Engineering Technology Associate in Applied Science degrees from ISU's Energy Systems Technology and Education Center (ESTEC) and the Eastern Idaho Technical College (EITC) one-year certificate in Radiation Safety. At "no growth" levels at the INL, these programs can likely support INL needs; however, the Nuclear Operations Engineering Technology program must receive sustained funding past the Spring 2013 semester in order to do so. With growth of INL programs and/or regional nuclear businesses, it is projected that technician graduation rates will fall short of the need in the nuclear operations area and the instrumentation, electrical and mechanical maintenance arenas. As increasing retirements hit the national nuclear sector, competition for nuclear graduates in these disciplines will continue to increase. This will impact the number of operations and maintenance graduates available to the INL.

EITC's Radiation Safety program supports INL, but in most cases, graduates from this program are employed at other DOE sites, commercial nuclear facilities, dosimetry laboratories, medical facilities, accelerators, independent and university research facilities that work with radioactive material and outage providers nationwide to acquire work experience. This program can be revised as INL demand for technicians is indicated.

Although the analysis presented here is based on simplistic assumptions, it is unlikely that a more detailed analysis would alter the conclusion: ***In summary, at their current rate of degree production the Idaho universities and technical colleges will not be able to meet the work force needs of the INL and associated industries in the future; this shortfall is especially pronounced at the doctoral and master's level.*** The INL should be encouraged to work with the Idaho universities and technical colleges to address these shortages, particularly at the graduate level.

2. *Summarize the challenges related to age of existing nuclear workers and impending retirements in both civilian and defense related nuclear establishments.*

Data gathered on the age distribution of workers in the commercial nuclear power sector points to a heavy reliance on employees in the 50-and-older age range. Though younger people are entering the field at increasing rates, a dearth of 40 to 50-year-old workers is evident. The state of the nation's economy has created a situation where positions have not opened up to bring in new people and build skills. A knowledge drop off could occur at some point should older workers stop delaying retirement as well as the possibility of a sudden staffing demand elsewhere. Simply put, the age distribution in the nuclear workforce sorely lacks bench strength to acquire the knowledge necessary to ensure effective and timely knowledge transfer. Based on age distribution data from the INL, a similar situation of heavy reliance on older workers exists

with 1,900 of the INL's 3,940 staff over the age of 50 and more than 1,100 over the age of 55. The median age range is 50-54.

The appendix includes a graphic of survey results by the Nuclear Energy Institute showing the age distribution of the commercial nuclear sector described above. (Please see Appendix C.) **The data profile reinforces the lack of replacement workers to meet future demand as large numbers of current retirement age employees leave the workforce and a need for planning to address the potential knowledge loss.**

3. *Summarize the ability of domestic educational programs to produce qualified graduates and review any opportunities and/or requirements associated with expanding the number of foreign workers as part of the nuclear workforce.*

Two-year Programs

The Nuclear Uniform Curriculum Program (NUCP) is an industry-led partnership with 2-year educational institutions that gives students a complete nuclear knowledge base with a standardized and transportable education and training program making them eligible for employment in the commercial nuclear industry nationwide.

The NUCP was developed to quantify the need for nuclear plant workers, define industry approved curriculum, and implement the right number of programs. The intent is that graduates could be waived or exempted from portions of required initial training. Students have the opportunity to substitute their education for training once employed. Successful completion of the industry-defined curriculum results in conferral of a National Academy for Nuclear Training Certificate. The certificate states that the student has successfully completed nuclear fundamental training objectives and may allow certified students to bypass fundamental training topics once employed in a nuclear facility. Nuclear professionals are trained under the NUCP at 38 community colleges in a cohesive manner to ensure consistency with the overarching principle of safety above all else. The Nuclear Operations Technology Program and the Instrumentation and Control Program at ISU's ESTEC are approved NUCP degree programs.

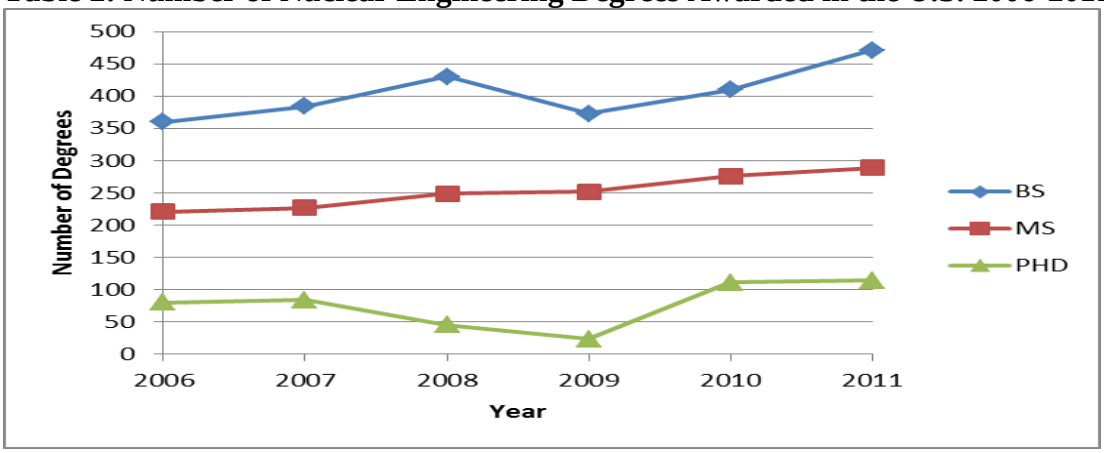
Four-year Programs

Table 2 below shows the number of degrees awarded in nuclear engineering by U.S. universities between 2006 and 2011[6]. In 2011 a total of 471 BS, 289 MS, and 114 PhD degrees were awarded in the United States. The numbers represent a 30 percent increase in BS and MS degrees awarded in 2011 compared to 2006 and a 43 percent increase in PhD degrees for the same time period. Twenty-nine universities awarded degrees (BS, MS, or PhD) in nuclear engineering in 2011. The top ten[7] universities accounted for 69 percent of the degrees awarded. Idaho universities accounted for 2 percent of the total degrees awarded.

[6] Integrated Postsecondary Education Data System (IPEDS) http://nces.ed.gov/ipeds/datacenter/.

[7] Pennsylvania State University, University of Michigan, Texas A & M University, University of Wisconsin, Purdue University, The University of Tennessee, Georgia Institute of Technology, University of Illinois, Massachusetts Institute of Technology, and University of Florida.

Table 2: Number of Nuclear Engineering Degrees Awarded in the U.S. 2006-2011



Use of Foreign Workers

Security restrictions at nuclear facilities limit the use of foreign workers. Data received from the Idaho Department of Labor's H1-B visa program showed that out of more than 650 applications, less than 15 involved INL/Battelle jobs.

Given the situation regarding security restrictions, the subcommittee has no specific recommendation concerning the use of foreign workers.

Regional Opportunities

Thriving energy industries and educational institutions whose programs serve those industries are present throughout the northwestern states and western Canada. Especially in light of the uncertainty of future federal funding, these existing relationships offer opportunities for expanded industry/education partnerships involving Idaho and the INL. An example is the Pacific NorthWest Economic Region (PNWER), which is a collaborative regional organization with private and public sector representation from the states of Alaska, Idaho, Montana, Oregon and Washington and the provinces of Alberta, British Columbia, Saskatchewan and the Yukon Territory. Its member organizations could provide much-needed support for regionally recognized certifications and degrees as well as innovative public-private workforce development collaborations. A model can be found in the WWAMI medical education program, a 40-year partnership between the University of Washington School of Medicine and the states of **W**ashington, **W**yoming, **A**laska, **M**ontana and **I**daho that provides publicly supported medical education for the five-state region. WWAMI and PNWER have also established Native American and First Nation initiatives that could inform efforts to further involve tribal stakeholders in extending education/workforce programs to their members.

Summary

Nationally, there has been growth over the last several years in the production of new nuclear technician and engineering graduates. Idaho higher education institutions

represent a small fraction of these totals. Security restrictions limit the ability to employ foreign workers at nuclear facilities. However, opportunities exist for regional collaborations to further public-private involvement in nuclear energy education/workforce development.

4. *Summarize how Idaho's programs/institutions compare to other state and federal education programs or institutions that address workforce training for the nuclear industry.*

Thirty-nine higher education institutions in 28 states offer bachelors, masters or doctoral programs in nuclear science and engineering. Idaho is one of nine states with more than one institution offering such degrees: Idaho State University (BS, MS and PhD) and the University of Idaho (MS and PhD).

Thirty-eight technical schools in 24 states offer National Nuclear Uniform Curriculum-recognized associate in applied science degrees (AAS) in the areas of nuclear operations, nuclear maintenance, radiation protection and chemistry. Idaho State University's Energy Systems Technology and Education Center offers two industry-recognized and approved degrees in Nuclear Operations and Nuclear Instrumentation and Control.

Nuclear Research Funding

The Nuclear Energy University Partnership (NEUP) is a major contributor to nuclear science and engineering funding. A listing of NEUP funding shows that Idaho was third highest among states awarded NEUP grants between 2009 and 2011: Idaho - $13.8 million, Texas $14.7 million and Wisconsin - $16.8 million.

The appendix includes graphics showing the distribution of institutions with degree programs and NEUP funding nationwide. (Please see Appendices D and E.) The data shows that **the quality of Idaho's nuclear programs/institutions is comparable to other states as demonstrated by the high degree of success in federally funded peer reviewed nuclear energy research programs.**

5. *Recommend steps that need to be undertaken to correct any deficiencies or opportunities that may exist to strengthen Idaho's competitiveness in developing workforce solutions for the industry.*

Please see the Recommendations section above.

6. *Outline opportunities for the INL to enhance the development of new nuclear technologies in conjunction with Idaho's universities.*

The activities described in the Recommendations section will only be accomplished with the active participation and collaborative involvement of INL management, Idaho Department of Labor, Idaho Department of Commerce, Idaho Department of Education, the Office of Professional Technical Education and Idaho's universities and technical colleges. Continued and expanded access to INL staff and facility resources underpin the anticipated results involving

CAES, ESTEC, a Polytechnic Institute and the Nuclear Talent Task Force strategies outlined previously. Therefore, the subcommittee recommends strong collaboration between the organizations named above to consider future opportunities in nuclear energy technology.

Appendix A
Nuclear Talent Task Force Proposed Structure

Mission

Provide a consolidated focus on the future workforce of the state and regional nuclear industry.

Strategic Objectives

- To establish priorities and coordinate activities among industry, government, community-based organizations and academia regarding the state's and region's emerging nuclear workforce issues.
- To articulate technical input to State Labor, Education and Commerce policy concerning the imperative to meet staffing demands for the nuclear industry.
- To recognize, enhance and/or sustain existing programs aimed at retaining current and recruiting new staff to existing, new or expanding businesses, and to provide counsel to the establishment of new programs where needed.
- To communicate workforce issues affecting the nuclear industry to industry stakeholders.

Core Membership

Nuclear Operations/Facility Contractors
Nuclear Research and Development Organizations
Key Nuclear Suppliers
Idaho American Nuclear Society
Nuclear Industry Support Organizations
State Government Agencies (Labor, Commerce and Education)*****
Organized Labor
Academia (all two and four-year schools having/seeking relevant programs)
Community-based Organizations

Number of Meetings

Two meetings each year - summer and winter
Lodging and meals provided

***If the subcommittee recommendation is accepted, the Nuclear Talent Task Force needs to be structured with a close affiliation to the Idaho Workforce Development Council and Department of Labor.**

Appendix B
INL Workforce Profile

7.1. Profile of Workforce to Maintain Core Capabilities

As part of workforce planning, INL managers develop annual staffing projections relative to future hiring needs necessary to support their current and future missions. The projections are based on skills gap analyses for anticipated future demands and to address possible attrition due to retirement. As the average age of an INL employee is 47.5 years and 28% of all employees are retirement eligible (55 years of age or older), planning for attrition and engaging in appropriate knowledge transfer is particularly important. Attracting and developing a highly skilled workforce to maintain and enhance the laboratory's core capabilities requires a multi-faceted approach. A qualified workforce with specialized knowledge, skills and technical expertise is required to fulfill INL's RDD&D mission and help sustain public confidence in the safety of nuclear science and technology. INL has embraced a global approach to recruiting and has significantly increased the hiring of foreign nationals (for programs not requiring clearances) for post-doctoral (typically 1-3 yr appointments) and permanent positions. Since contract assignment, INL has hired more than 50 strategic level hires to develop and/or enhance the RDD&D laboratory's capabilities.

- **Applied Materials Science and Engineering** – INL employs 60 materials engineers, primarily in Materials Science & Engineering department of E&E, the Nuclear Fuels & Materials division of NS&T, and the Armor & Explosives/Material Technology department of NHS. Only 16.6% of materials engineers are retirement eligible, and nearly half (48.3%) were hired since the BEA contract. Furthermore, 48.3% have PhDs. Materials science and engineering have been significant growth areas for INL.

- **Applied Nuclear Science and Technology** – To support this core capability, INL employs 27 physicists in addition to the chemical engineers and nuclear/radio chemists discussed below. 44% of the physicists are retirement eligible (and 29% are above the average age of retirement (61)), 60% have PhDs, and only 22% have been hired since contract assignment. This has not been an area of growth for the laboratory. Effective knowledge transfer is a significant concern for this population of employees.

- **Chemical Engineering** – INL employs 80 Chemical Engineers and Chemical Scientists. They support a wide variety of functions and departments including Interfacial Chemistry department, the Advanced Process & Decisions Systems department, the Aqueous Separations & Radiochemistry department, and the Pyroprocessing Technology department, and the Chemical Demilitarization/Chemical, Biological, Radiological, Nuclear and Enhanced High-Yield department. 16.25% of the engineers and scientists are retirement eligible, 31% have been hired since contract assignment, and 51% have PhDs.

- **Cyber and Information Sciences –** INL employs 52 cyber security technical analysts, cyber security policy analysts and computer security researchers in Cyber Security department of NHS, and the Cyber Security department of Information Management.

62% of these analysts and researchers were hired after contract assignment, indicating this is an area of growth with rapidly changing technology. Hiring for this area is highly competitive, as the workforce tends to be younger than the lab average (only 19% are retirement eligible compared to 28% of the laboratory population). The educational profile is dissimilar from other technical areas in that only 2% of employees have a PhD, and only 4% are SE5s.

- **Decision Science and Risk Analysis** - This core capability is supported by a broad variety of 136 scientists, engineers and analysts specializing in environmental risk assessment, human factors, mathematics, modeling & simulation, probabilistic risk analysis, regulatory compliance, statistics, systems/value engineering, and vulnerability assessment. INL has established departments for: Risk, Reliability and NRC Program; Human Factors, Controls & Statistics; Fuel Modeling & Simulation; and Armor & Explosives/Material Technology. The Environment Safety & Health directorate provides a significant environmental regulatory compliance service across the laboratory. 33% of these employees are retirement eligible, and several of the disciplines (such as modeling & simulation, probabilistic risk analysis and vulnerability assessment) are highly sought in the market place. 30% of this group has been hired since contract assignment, and 18% have PhDs.

- **Environmental Subsurface Science -** To support this core capability, INL has a team of 32 scientists and engineers specializing in earth & life science, environmental engineering, geology, geophysics and hydrology. They work in the Environmental Engineering & Technology and the Earth & Water Resource Science departments of E&E. 33.3% are retirement eligible (which is higher than the lab average of 28%). Hiring in this area has been minimal as only 15% of these scientists and engineers have been hired since contract assignment. 25% have obtained PhDs.

- **Mechanical Design and Engineering –** The Mechanical Design and Engineering core capability applies the principles of physics and materials science to analyze, design, test and validate advanced machines and tools. Primary supporting disciplines for this capability include physics, materials science, aerospace engineering, mechanical engineering, electrical engineering and computational science. Physics, materials science, electrical engineering, modeling & simulation, statistics and mathematics are discussed within other capabilities herein. In addition to those professionals, INL employs 112 mechanical engineers and 2 aerospace engineers to support the Mechanical Design and Engineering core capability. Hiring in this area has been robust since contract assignment as evidenced by the fact that only 20% of mechanical engineers are retirement eligible and 42% of all mechanical engineers have been hired since contract assignment. Nearly half of the mechanical engineers are early in their careers (applied engineers and scientists/engineers levels 1, 2 and 3), and only 17% have advanced degrees. INL has hired many recent college graduates (19 RCGs in last five years) who are still with the lab.

- **Nuclear and Radio Chemistry –** INL employs 90 nuclear and radiochemistry professionals, 79 of whom are scientists and engineers. Of the scientists and engineers,

52% have PhDs and 19% are retirement eligible. There has been significant hiring of new, junior scientists and engineers in this field as evidenced by the fact that 46% of the scientists and engineers are SE0100 – SE0300.

- **Nuclear Engineering** -. INL employs 110 nuclear engineers, and primarily in the following departments: Nuclear Nonproliferation; Reactor Physics Analysis & Design; Thermal Science & Safety Analysis and Experimental Program; Irradiation Testing; and Experiment Design & Analysis. 24% of the nuclear engineers are Scientist Engineers (SE) Level 5, 6 and 7, indicating a robust committee review process has been undertaken to review eligibility for these senior levels. Three are Laboratory Fellows (SE7). 30% of nuclear engineers are retirement eligible, and 50% have been hired since contract assignment in 2004. 42% of all nuclear engineers have PhDs.

- **Power and Electrical Engineering -** INL employs 43 electrical engineers primarily in the Energy Storage & Transportation Systems and the Robotics & Intelligent Systems departments of E&E, and across the Applied Engineering (AE) directorate. AE deploys electrical engineers to support research and operations, including the MFC laboratories and hot cells, and the ATR. The Power Grid department of NHS employs 5 power engineers. 31% of these electrical and engineers are retirement eligible, 25% have been hired since contract assignment, and 12.5% have PhDs.

7.2 Obstacles and Strategies

INL must maintain and amplify its ability to: attract the best talent available; develop staff and management internally to strengthen the existing talent pool; retain our valued human resources; and appropriately reward.

Obstacles and factors impacting INL's to attract, engage, develop and reward a highly qualified workforce include:

- The estimated percentage of employees eligible to retire (employees age fifty-five and older with at least five years of service) will continue to grow from twenty-six percent to approximately fifty percent of the workforce by the end of 2015. The average age of an INL employee is 47.5.

- Federal budget cuts are impacting programs in FY12, and significant cuts in FY13 are anticipated. INL employees are entering their second year of a federal salary freeze that may be extended.

- The competition for top engineering and scientific talent is significant, and in part impacted by decades without nuclear facility construction. This hiatus resulted in reduced enrollment and forced closures of university and skills-based nuclear programs. Private industry is recovering ahead of the government sector which will drive competition up within the already limited engineering and scientific labor markets.

- INL is conducting workforce restructuring activities to right size the organization for the current and anticipated reductions to business volume.

- Private industry is offering inflated starting salaries, generous signing bonuses and lucrative incentive compensation bonuses with significant multi-year payback provisions.

Strategies that are being implemented to combat the obstacles include:

Attract:

- Development of staffing projections based on skills gap analysis and anticipated attrition due to retirements
- Utilization of demographics to drive hiring that will result in a more diverse workforce
- Multi-faceted recruiting approach including employee referrals, professional societies, electronic and print media, social media, technical presentations at universities, conference and career fairs that target women and minorities, university career fairs, technical and scientific job boards focused
- Targeted recruiting at leading university programs directly related to INL's core capabilities

Engage:

- Participation in Gallup Q12 survey with robust impacting planning to positively impact employee engagement
- Establishment of Communities of Practice, including the Knowledge Transfer COP, the Researcher COP and the Engineering COP
- Quality of life initiatives: increase in part-time benefits, flexible work schedules, new gyms and cafeterias, active employee association, Team INL (focused on charitable initiatives)

Develop:

INL employees

- Scientist Engineer Development Program for junior level scientists and engineers.
- An array of leadership development programs including License to Lead, Mandate to Manage, and Front Line Leadership Fundamentals
- Employee development planning and rotational assignments for high potential and succession candidates
- Mentorship and Coaching programs
- Postdoctoral program
- Laboratory Directed Research and Development opportunities
- Brown bag sessions with INL researchers and outside experts

Future scientists and engineers

- Collaborative programs with Idaho research universities, implemented through CAES
- Research collaborations with the National University Consortium (NUC), comprised of five leading nuclear engineering programs and implemented through INEST

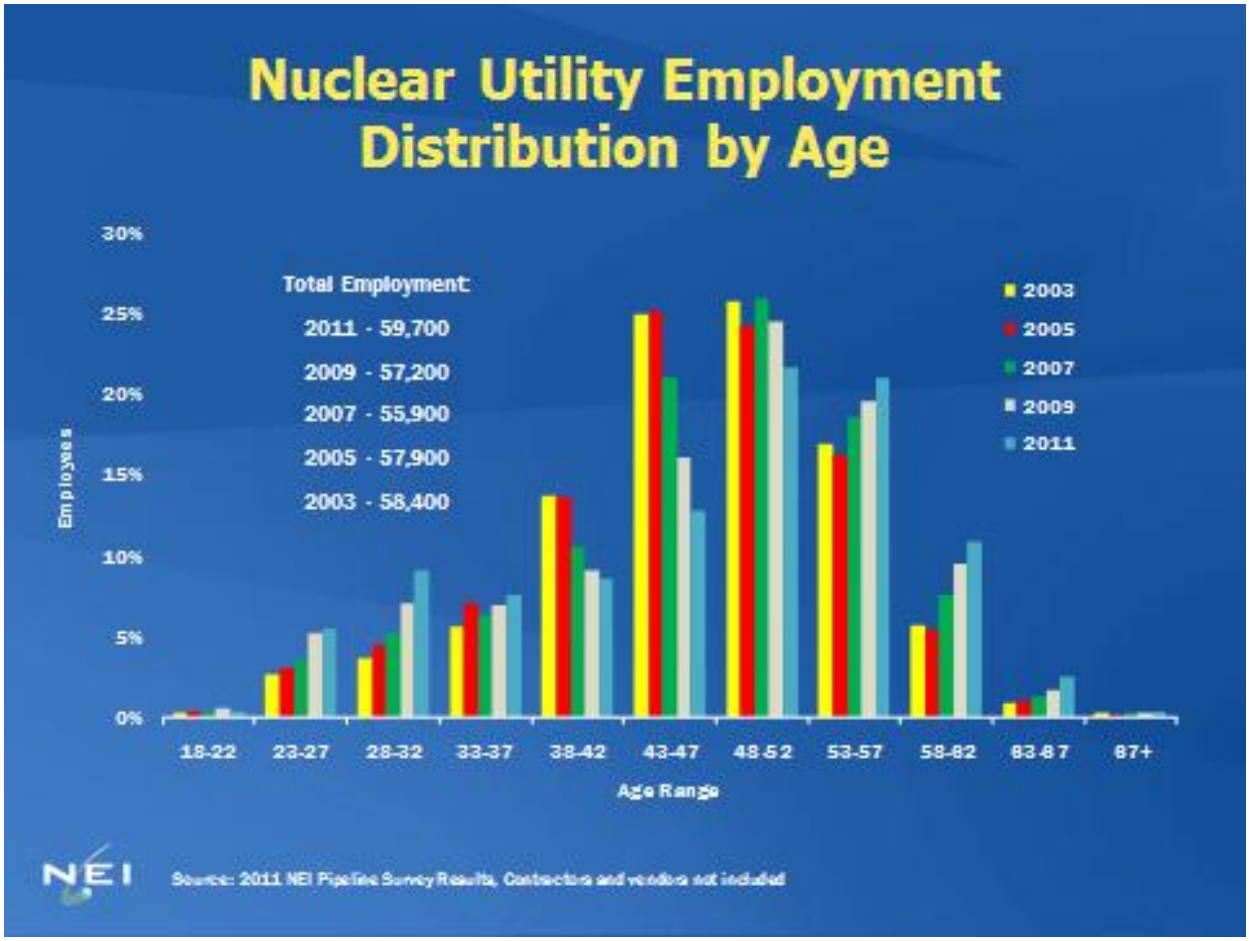
- Administration of the NEUP, providing opportunities for engineering students across the U.S. to participate in DOE-NE R&D
- Training a new generation of experimentalists through the ATR NSUF
- INL support of, and participation in, ISU, U of I and Boise State programs
- Opportunities for students and teachers to enhance their education through internships; fellowships; joint appointments; and science, technology, engineering and mathematics education, including workshops for high school physics teachers

Reward:

- A robust program for incentive compensation, bonus and expanded recognition awards to recognize contributions at various levels of the organization
- Market-based pay to ensure competitive salary offers to candidates, appealing relocation packages, and robust benefits package

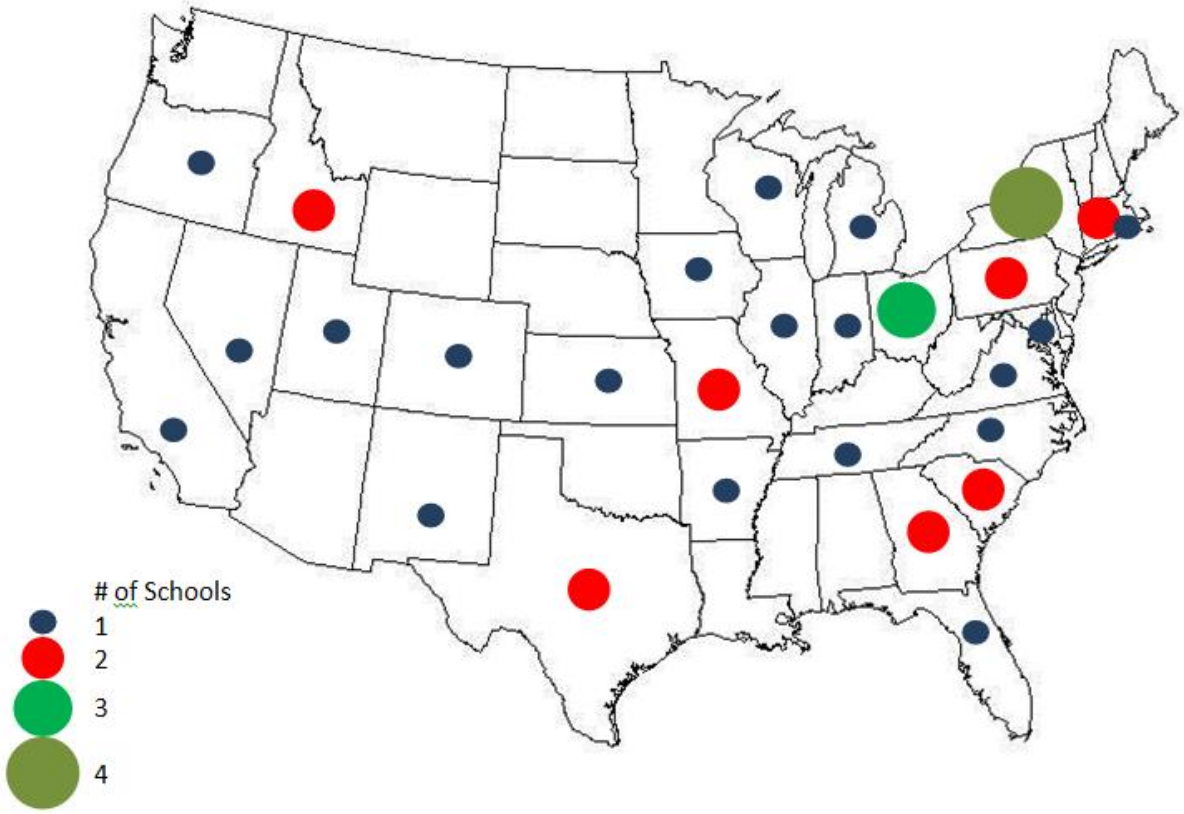
INL is also engaging in right-sizing and cost-saving activities to ensure the availability of funds for appropriate reinvestment in people, infrastructure and capability development/enhancement. As noted, INL is engaging in workforce restructuring, as well as appropriately re-competing benefits for cost savings.

Appendix C
Distribution of Employment by Age



Appendix D
Higher Education Programs in Nuclear Energy

Institutions with Degree Programs in Nuclear Science and Engineering



Listing of Universities and Degrees Offered

Arkansas Tech University [MEng, BS]

University of California, Berkeley, [BS,MS,PhD]

Colorado School of Mines, [MS, PhD]

University of Florida, [BS,MS,PhD]

Georgia
Georgia Institute of Technology, [BS, MS,PhD]

Southern Polytechnic State University, [Minor, MS]

Idaho
Idaho State University, [BS,MS,PhD]
University of Idaho, [MS,PhD]

University of Illinois at Urbana-Champaign, [BS,MS,PhD]

Purdue University, Indiana, [BS,MS,PhD]

Kansas State University, [BS,MS,PhD]

University of Maryland, College Park, [MS,PhD]

Massachusetts
Massachusetts Institute of Technology, [BS,MS,PhD]
University of Massachusetts Lowell, [BS,MS]

University of Michigan, Ann Arbor, [BS,MS,PhD]

Missouri
Missouri University of Science and Technology, [BS,MS,PhD]
University of Missouri, [MS,PhD]

University of Nevada, Las Vegas, [MS]

University of New Mexico, [BS,MS,PhD]

New York
Cornell University, [BS,MEng,PhD]
Polytechnic Institute of New York University, [Minor]
Rensselaer Polytechnic Institute, [BS,MS,PhD]
United States Military Academy, [BS]

North Carolina State University, [BS,MS,PhD]

Ohio
Ohio State University, [MS,PhD]
Air Force Institute of Technology, [MS, PhD]
University of Cincinnati, [MS,PhD]

Oregon State University, [BS,MS,PhD]

Pennsylvania
Pennsylvania State University, [BS,MS,PhD]
Drexel University, [Minor] Pennsylvania

University of Rhode Island, [Minor]

South Carolina
South Carolina State University, [BS]
University of South Carolina, [ME,MS,PhD]

University of Tennessee at Knoxville, [BS,MS,PhD]

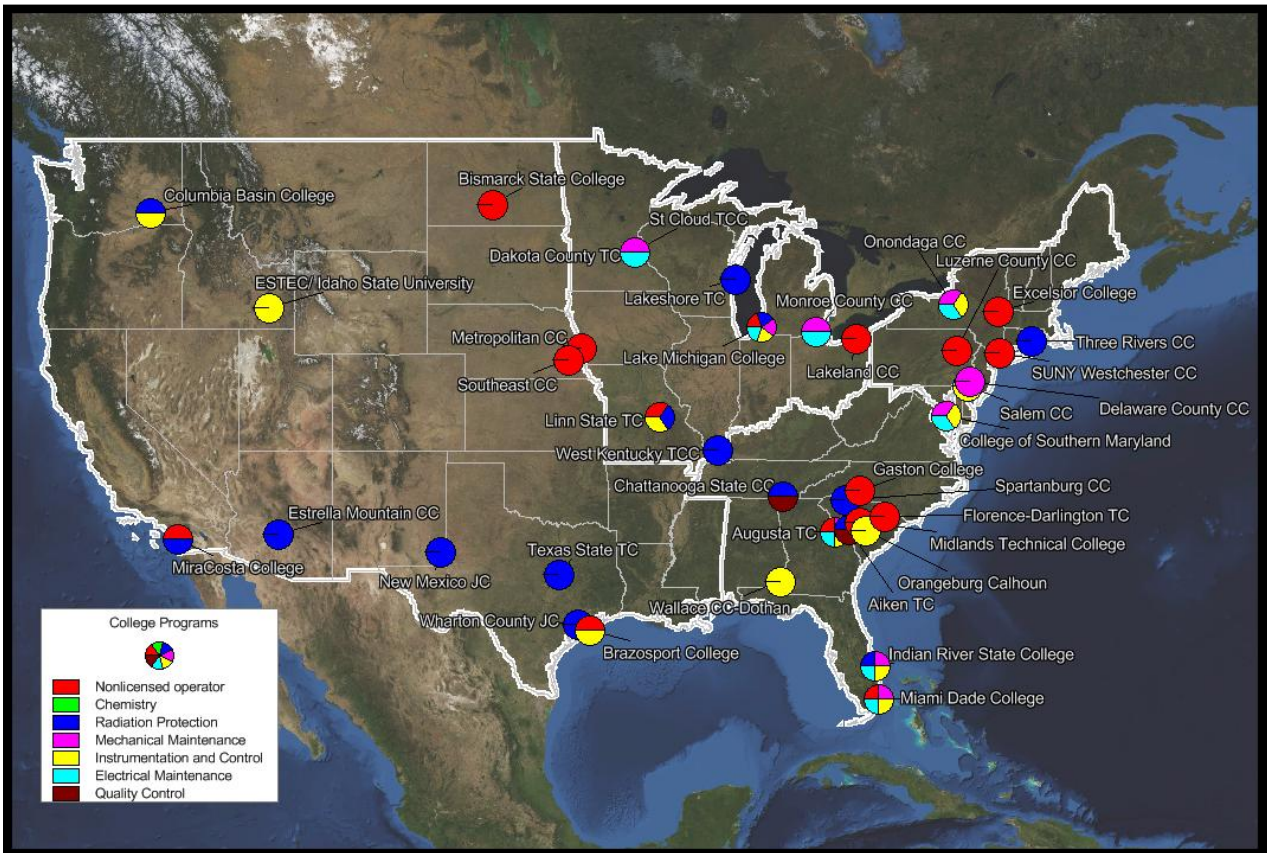
Texas
Texas A&M University, [BS,MS,PhD]
University of Texas at Austin, [MS,PhD]

University of Utah, [ME,MS,PhD]

Virginia Commonwealth University, [MS]

University of Wisconsin-Madison, [BS,MS,PhD]

Approved Nuclear Uniform Curriculum Technical Schools

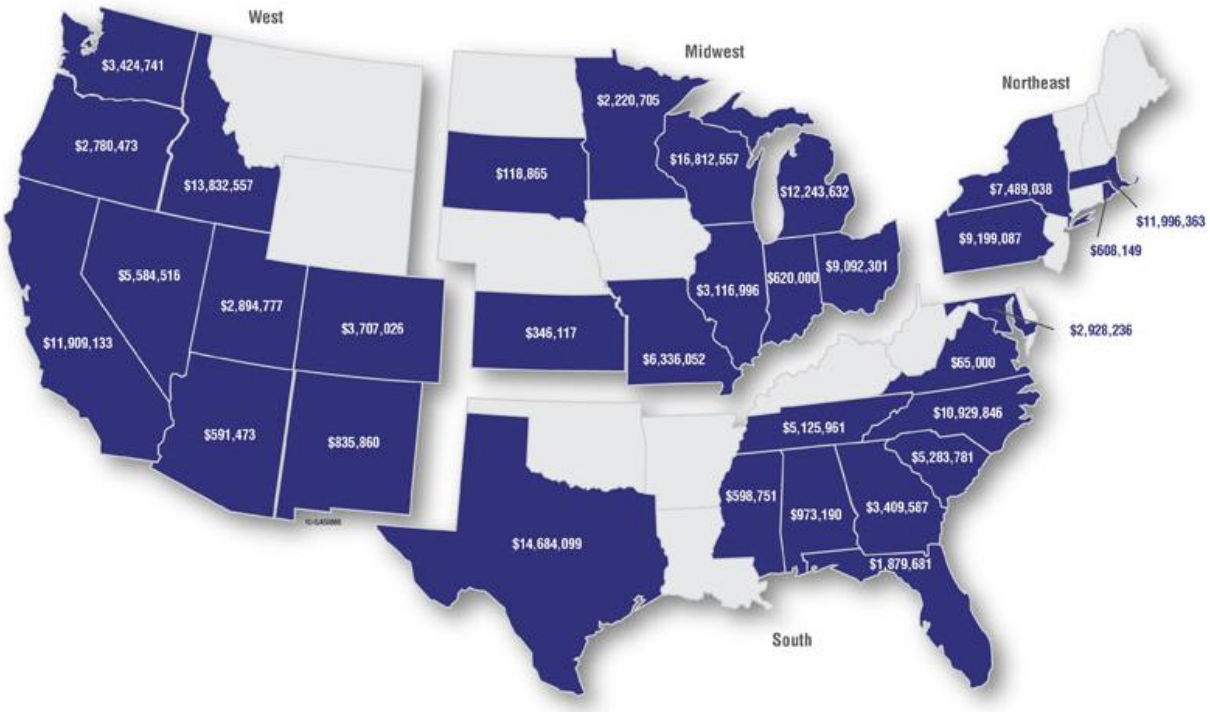


Appendix E
Funding Distribution – Nuclear Energy University Partnership (NEUP)

One of the major contributors to nuclear science and engineering funding is the Nuclear Energy University Partnership (NEUP). Below is a summary of monies by state from 2009-2011.

NEUP Funding: 2009-2011

Since 2009, NEUP has awarded more than $170 million in research projects at dozens of U.S. colleges and universities.



Source:
https://inlportal.inl.gov/portal/server.pt/community/neup_home/600/fy11_announcement_archive

Of the states awarded NEUP funding, Idaho received the third highest amount, $13.8 million. Only Wisconsin and Texas received more funding at $16.8 and $14.7 million, respectively.