

2006-2657: THE 2+2 SCHOLARS PROGRAM: COLLABORATIVE UNDERGRADUATE NUCLEAR ENGINEERING EDUCATION IN IDAHO

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The 2+2 Scholars Program: Collaborative Undergraduate Nuclear Engineering Education in Idaho

Abstract

The 2 + 2 Scholars Program brings together nuclear engineering undergraduate students from three Idaho universities - Idaho State University (ISU), the University of Idaho (UI), and Boise State University (BSU) - to spend their junior and senior years in Idaho Falls, attending classes at University Place (a joint campus of ISU and UI) while working as interns at the Department of Energy's Idaho National Laboratory (INL) and using INL facilities for coursework. Scholarship funds are provided by the AREVA Group and the DOE.

How did it start?

In 2003, the Idaho State Board of Education approved the establishment of ISU's Institute for Nuclear Science and Engineering (INSE). The Institute, directed by Dr. Michael Lineberry, was created to encompass all things nuclear at ISU and to promote and facilitate collaboration with the INL. The Institute was designed to go beyond the traditional limitations of a college, because there are things happening in the Physics Department, in the College of Engineering, and in Biology and Medicine that are all very exciting and relevant to nuclear. INSE provides an opportunity to pull them all together and manage the momentum and the collaborations with the INL. The idea was for the Institute to span not only across colleges at ISU, but also across all three state universities - ISU, Boise State, and the University of Idaho. The University of Idaho offers expertise in mechanical and chemical engineering aspects of nuclear. Boise State focuses on energy policy issues and on nuclear materials. ISU contributes through its expertise in the more traditional areas of nuclear engineering and nuclear physics. It's a great combination that works to collaborate with INL. The universities can use what INL has, and in turn INL gets to use the university facilities. So, it's mutually beneficial.

The idea for the 2 + 2 program actually occurred at a meeting of all three of the universities' vice-presidents for research. It was kicked off in 2004, when the Idaho State Board of Education approved a bachelor of science in Nuclear Engineering degree for ISU. Before that approval, the state of Idaho didn't have a nuclear engineering bachelor's degree, but rather an ABET accredited interdisciplinary degree with nuclear emphasis at ISU. With this new degree program in the state, and the new mission of INL to become the nation's center for nuclear technology, all the ducks were in a row to set up an initiative like 2 + 2.

The Scholars Program began in the fall of 2005, in close collaboration with the Idaho National Laboratory (INL) through its Center for Advanced Energy Studies (CAES). This program is part of a larger collaborative effort between INL-CAES and the U.S. nuclear education infrastructure, as represented at least initially by the Idaho universities mentioned above (the "Idaho University Consortium" (IUC) as it's known for purposes of collaboration with INL); and a "National University Consortium" (NUC - named in a companion paper on CAES). The main purpose of the collaborative relationship is to play a major role in revitalization of nuclear science and engineering education and research in the U.S.

What is the 2 + 2 Scholars Program?

As presently structured, sophomores within the Colleges of Engineering at the three IUC institutions are selected for 2+2 scholarships, and then relocate to Idaho Falls (the University Place campus, which presently has over 3000 students total from ISU and UI), enrolling as Idaho State nuclear engineering juniors. The scholarships are funded by a grant from the AREVA Group (\$50,000) and the DOE Industry Matching Grant program (\$40,000). CAES is working with INL partners in the Battelle Energy Alliance and other nuclear industry sponsors to attract additional sponsors in future years. Under the 2+2 program, tuition and fees are paid, a modest book allowance is provided, and a stipend of \$350 per month during the academic year is awarded to junior and senior students.

Table 1. Nominal schedule for the 2+2 Nuclear Engineering Scholars.

Fall Jr. year	Spring Jr. year
Full-time course load, including: <i>Introduction to Nuclear Engineering</i> Numerical Methods Thermodynamics Advanced Engineering Math	Full-time course load, including: <i>Fluid Mechanics</i> <i>Neutron Reactions and Transport</i> <i>Eng Economics & Management</i> <i>Nuclear Instrumentation Lab</i>
Summer Jr. to Sr. Start of <i>Practicum Experience</i> with the INL. Nominally 40-hrs/wk, including completion of <i>Nuclear Systems Lab</i> course	
Fall Sr. year	Spring Sr. year
Continuation of <i>Practicum Experience</i> at the INL, ~ 20 hrs/wk and three courses: <i>Heat Transfer</i> <i>Design of Nuclear Fuel Systems</i> <i>Project Design I</i>	Full-time course load, including: <i>Energy Systems</i> <i>Thermal Fluids Lab</i> <i>Eng. Probability and Statistics</i> <i>Nuclear Materials</i> <i>Project Design II</i>

Collaboration with CAES and INL comes about in several fundamental ways. First, there will be a six-month “practicum” beginning the summer between the junior and senior years, which will include participation in major R&D projects at the INL, including a start on the required senior design project. Second, efforts are nearing completion to arrange the nuclear laboratory course to be taught during the practicum period at certain of the unique INL nuclear test facilities. Third, special adjunct teaching arrangements are being made with INL/CAES researchers both to help with the teaching load at ISU and UI, but more importantly to offer special electives that take

advantage of the very specialized INL/CAES nuclear expertise. Special topics include nuclear materials, radiochemistry, space applications and proliferation resistant technologies.

At the present time, the degree offered is a B.S. in nuclear engineering from Idaho State. Discussions are in progress that would make the degree a joint award of both the institution that provided the first two years' of study and ISU. In other words, students transferring from UI would have the names of both UI and ISU on the degree and the equivalent for BSU transfer students.

Now . . .

The first 2 + 2 class started in the fall of 2005 with six students - four from ISU, one from Boise State, and one from the University of Idaho. Course work for the scholars' junior year has been somewhat typical of any nuclear engineering program nationwide. Differences among individual students exist largely because of the program (e.g. mechanical, electrical, or civil) from which each student came. What the students have in common are the core nuclear courses, which they take together and through which they support each other.

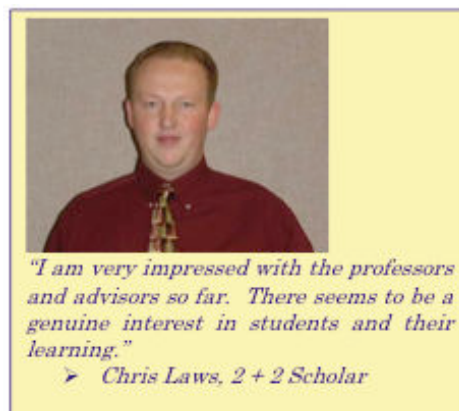


Figure 1. 2 + 2 Scholar Chris Laws switched from electrical to nuclear engineering upon becoming part of the program. He is very happy with the change.

In addition to the coursework, the Scholars share special field trips and professional development opportunities, made available through Program funding but open to students outside the scholarship recipients. During this inaugural year, field trips include tours of several INL world class facilities (Experimental Breeder Reactor – II, the large, inert environment hot cell at the Fuel Conditioning Facility, the Advanced Test Reactor, its critical facility and its simulator), tour of an operating nuclear power plant (through Northwest Utilities), and an operating nuclear fuel fabrication facility (through AREVA-Framatome, ANP.) All 2+2 students will be funded to attend, and are expected to present at, the annual American Nuclear Society (ANS) Student Conference, to be held this year in late March at Rensselaer Polytechnic Institute.



Figure 2. 2 + 2 Scholar, Francine Rice, is also Outreach Chair for the ISU Student Section of the American Nuclear Society.

Also notable is the revived ISU student section of the ANS, to which several of the 2+2 students were elected by other engineering students to serve as officers. Both membership and level of activity have increased drastically over levels of any previous year. Student members have initiated, and participated in, a variety of outreach efforts, have worked with the College of Engineering to promote the degree program on campus and state-wide, have arranged for speakers on a number of nuclear-related topics of interest to students, and have increased the level of collaborative interaction with the local professional section of the ANS.

At the time this paper is being written, plans are being formalized for the summer to fall practicum experience for the Scholars. They will spend nominally one-half to three-quarters of their time, from June through December of the junior to senior years, working on a nuclear project with professionals at the INL. Scholarship monies will continue to cover any tuition expenses, but they will be paid a stipend for their work from the INL. During this time they will also be continuing course work, especially the required reactor laboratory course, which they'll complete during the summer in a special pilot program using the INL's Advanced Test Reactor Critical Facility and the ATR Simulator for many of the course experiments. When the fall term begins, Scholars will continue working part time at the INL, while taking three required courses including the first of two semesters of their Senior Design Project course. Ideally, the project work at INL will feed into, or even become, the project for the design course.

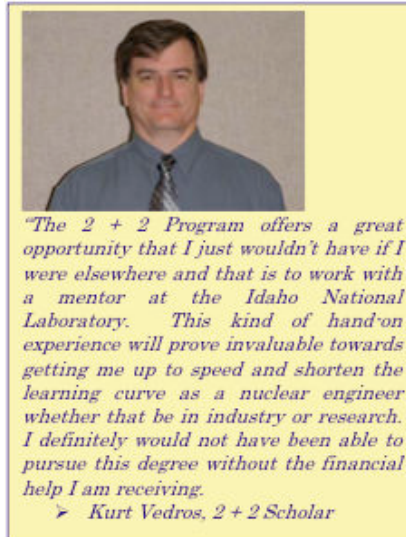


Figure 3. Scholar Kurt Vedros spent time in the U.S. Air Force and industry before going to school for his engineering degree. He brings a unique and valuable perspective to the Program.

The IUC is trying to build an emphasis in Idaho on fuel cycle research and development, but there are many areas of research/project interest, such as space nuclear power, nuclear nonproliferation, energy policy and systems studies, fuel cycle chemistry and radiochemistry, and energy and the environment. The students will work in areas that are of interest to them, but involve activities that are going on right now at INL.

... and Next

The goal in future years is to add to the number of juniors that enter the 2+2 Scholar's program. Depending of course on the outcome of the fund raising effort, it is hoped that 8-10 juniors will be enrolling for academic year 2006-2007, while the initial class of six participants will graduate in about August 2007. The goal is to have an incoming class of 12 students every year. An incoming class, consisting of 12 juniors, would follow the class of 12 seniors already in the program, for a total of 24 students in the program each year.

Other schools will also be brought into the Program. There is great enthusiasm for, and current discussion to affect, "3 + 2" or "2 + 2" agreements with the Lewis and Clark State College in Lewiston, Idaho and the Brigham Young University – Idaho in Rexburg. Outside the state of Idaho, the NUC schools have also expressed interest in their undergraduate students having exposure to the opportunities afforded by the Scholars Program. Like the INL, other DOE National Laboratories have internship programs, and even scholarships, for undergraduates in many fields of study. However, the authors are aware of no other university program that incorporates a long-term lab internship and lab facilities into the curriculum.

While we strive to recruit and fund an equilibrium number of 2+2 Scholars over the next several years, there will also be an effort to grow the infrastructure to support the overall nuclear engineering program at ISU, and especially Idaho Falls. Faculty are being recruited and complete lab course capability in Idaho Falls is being pursued.

Conclusion

While the Scholar's program is new, both ISU and the University of Idaho have long-standing nuclear engineering programs, largely motivated by the presence of the federal nuclear R&D site that is now the INL. Also, there are a number of nuclear engineering undergraduates at ISU who are not now participating in the 2+2 program. But if the 2+2 program does not represent a new undergraduate nuclear engineering program, it certainly represents a rejuvenation of the existing one. The graduate student population of nuclear engineers is growing significantly as well, with their research arranged through CAES at the INL, but that is beyond the scope of this paper.

It's an exciting time in nuclear engineering education worldwide. The enthusiasm among the students, faculty and professionals in the field is contagious. Although a modest contribution to addressing the needs for new nuclear professionals world-wide, Idaho's 2+2 Nuclear Engineering Scholars Program has promise as a unique and valuable way to offer a rich educational experience to tomorrow's nuclear workforce.

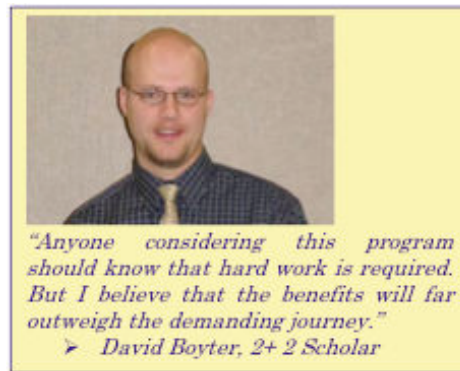


Figure 4. As Scholar David Boyter demonstrates, the students, themselves, become the best spokespeople for the Program.