Jim Lake has been active in ANS since he first signed up as a student member in the late 1960s.

Jim Lake (left), the new ANS President, and Andy Kadak, the immediate past-President, at the ANS Annual Meeting in June, at San Diego (Photo: Larry Foulke)

Lake: From technical achievement to technical leadership

By Patrick Sinco

When James Lake began his term last month as ANS president, it likely marked the beginning of another successful chapter in his long and outstanding career in the field of nuclear energy. Lake, director of Strategic Nuclear Business for the Idaho National Engineering and Environmental Laboratory, began his professional career in the early 1970s, and has been on the rise ever since. He has been responsible for notable original research and invention, has shown distinguished leadership in engineering design, and has been one of the strongest contributors to ANS.

Like many of today's engineering managers, Lake spent the first years of his career doing strictly technical work: first, as a graduate student at Georgia Institute of Technology, then as a senior and fellow engineer for Westinghouse. His accomplishments during this time, while a member of the Clinch River breeder reactor design team, were "fundamental, deep, and lasting," in the words of former Argonne National Laboratory–West Fuel Cycle Division director Michael Lineberry. Lake began his career as a technology and research manager 16 years ago, at what is now known as the Idaho National Engineering and Environmental Laboratory, and led the development of the innovative split-core high-flux reactor design, among other accomplishments. In his most recent position as director of Advanced Nuclear Energy Products, which he stepped away from in March, he was responsible for the conduct of more than 150 nuclear safety and technology programs, employing 250 scientific and engineering staff.

1944: Jim Lake is the youngest of the four generations of Lakes pictured here.

Lake has been active in ANS since he first signed up as a student member in the late 1960s. He has served as chair of the Reactor Physics Division and of the Idaho Local Section, and is currently a member of the ANS board of directors, among other distinctions. In 1992 he was elected Fellow for his technical leadership in the design of a new generation of nuclear energy systems, with applications in electric power generation, space propulsion, physical research, and materials production.

"What gets me buzzing in the morning and excites me about going to work every single day is the people and the exciting opportunities facing the nuclear industry in the future," Lake said.

The beginnings

James Alan Lake was born in Gary, Indiana, in the early 1940s. As a boy growing up, Lake—the son of a mechanic—was fascinated with tinkering. After spending one summer building a stereo from a kit, the future nuclear reactor designer was hooked. Lake said he enjoyed the intricacy of the project and witnessing the stereo come together in a fairly elegant fashion (and it worked).

1962: The engine of a Corvette lurks inside Lake's home-built hot rod, which he proudly displays.

It was automobiles, though, that the teenaged Lake would come to cherish. He and his dad built his first hot rod over the course of four years, and he said he all but lived in the garage during high school. The chopped and channeled 1931 Ford rumbleseat coupe, fitted with a Corvette engine, was the result of Lake's first methodical foray into engineering. Perhaps his success with the car—which he claims was never beaten by any Mustangs or Corvettes while obeying the speed limits, more or less, on the streets of Gary—reinforced his interest in engineering.

After high school, almost all of Lake's friends stayed in Gary to work in the steel mills. Lake said he was making "fantastic money" at the mills, and wasn't exactly eager to leave the job or his friends. But his mother, who at the time worked for an extension of Indiana University, had bigger plans for him: She was going to make sure her son went to college. "She was my inspiration and my conscience, and she made sure that I didn't wander far from that goal," Lake recalled.

In the fall of 1961, Lake was enrolled at Hanover College, a small liberal arts school located in southern Indiana near the Ohio River. Lake likened the school to the one portrayed in the movie *Animal House,* complete with strict rules of conduct and its own version of the meddling dean.

Hanover's dean would cruise the neighboring town of Madison (there were, of course, no bars on campus) looking for student cars still parked more than 30 minutes after the last movie let out. The owners of such cars, identified by Hanover parking stickers, were often invited to visit the dean the next day to explain their whereabouts the previous evening. Lake, however, declined to say how he learned of the dean's habits.

In the midst of courses on history, religion, and Russian, Lake found something he loved: physics. Although the values of a liberal arts education would serve him well throughout his career, his education was nevertheless lacking in mathematical physics. A classmate who had graduated a year earlier and had gone on to Miami University of Ohio alerted Lake to a prominent mathematical physicist named George Arfken who was teaching there.

Arfken had unconventional methods of motivating his students, and Lake credits his former professor for teaching him skills beyond just science. At the time, Arfken had just finished writing a textbook—*Mathematical Methods for Physicists,* currently in its fourth edition and considered by many to be the standard text on the subject—and his students were using a draft of the book in class. Arfken motivated his students to read the assignments by offering to pay a quarter to the first student to spot an error in the text. "I can't think of any other series of classes where the students *eagerly* read ahead. It's hard enough to read the assignment for the next day, but people would eagerly read ahead because if you could get just a page ahead of the next guy you could come out with two, three bucks," Lake remembered. "It really motivated us to study the equations a little bit harder."

After graduating with a master's degree in physics from MU (and after having been a classmate of 1996–97 ANS President Don Miller), Lake received an Atomic Energy Commission fellowship to attend Georgia Tech and study nuclear engineering, which Lake had decided was the career for him. "This was 1967," he said. "Nuclear was getting all kinds of press. Every utility CEO who was anybody in the business had to have his own reactor. It really looked like an exciting area, and it was heavily physics laden."

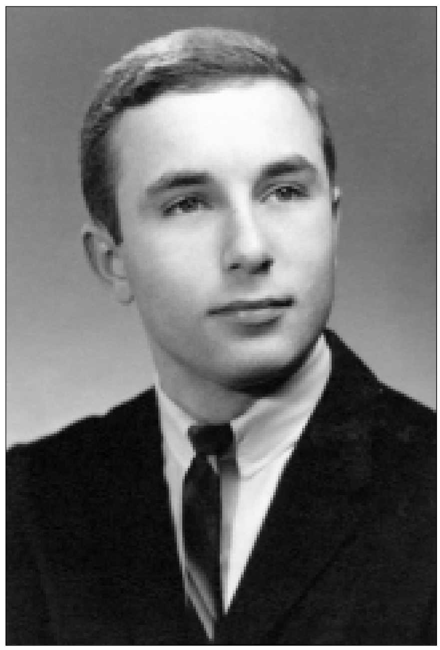
Soon, in a tiny office in the basement of the Georgia Tech Research Reactor building, Lake was at work on his thesis with his mentor, the late John Kallfelz (who was once editor of *Nuclear Science and Engineering,* published by ANS). "As I look back at various things I've done in my career, I probably have learned a tremendous amount from John Kallfelz," Lake said. "He was a consummate reactor physicist, an absolutely brilliant theorist. But, the thing that I learned the most from him was how to work with people. He had an uncanny knack for inspiring people to want to work with him . . . I hope I've been able to emulate a small fraction of that in my life."

Lake's thesis was on a phenomenon that led to difficulty in the interpretation of various steady-state and pulsed neutron physics experiments. It was eventually published in *NS&E.*

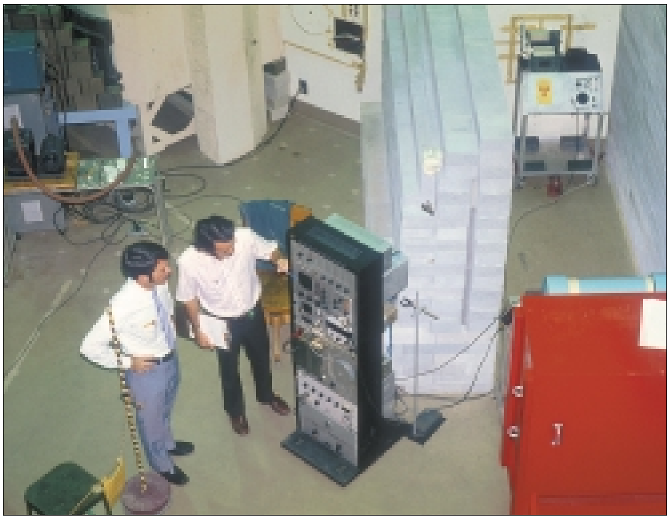
"This was a great thesis for me because I got to work with the people in the machine shop," he said. "I got to build things, do measurements, and work with the operators and the reactor. I had a ball."

Lake's experiments are credited with contributing substantially to proving the disappearance of a "fundamental mode" for the neutron energy spectrum in polycrystalline moderators smaller than a critical size. His discrete measurements of steady-state spatially dependent neutron spectra, together with time-dependent integral data published about the same time, validated this theoretical curiosity that had been postulated by such distinguished scholars as Noel Corngold, James Duderstadt, and Robert Conn. Although a large body of related data existed at the time, none of it appeared to support the theory of the disappearance of the discrete eigenvalue. To some, this phenomenon was just a mathematical abstraction. However, as long as the interaction of neutron fields in the simplest of media was not understood, there was a small breach in the credibility of reactor physics in general.

When not puzzling over discrete eigenvalues, Lake "contaminated" a large fraction of the Georgia Tech nuclear engineering department with the motorcycle trail-riding bug. Having parted with his beloved hot rod before moving to Atlanta—it did not have a trunk and so was of dubious utility during a move—Lake developed an interest in motorcycling, specifically the Bultaco Matador, a



1965: Lake from his days at Hanover College




1971–1972: Lake (right) at Georgia Tech with the late professor John Kallfelz; Lake at work on his thesis in the Georgia Tech Research Reactor building

Spanish two-cycle engine off-road bike. Lake made shrewd use of the graduate student's ability to work unusual hours, and would often be with his friends riding the trails near Atlanta during the best times of day. When not racing, he found the perfect parking spot where no one would touch his bike: on a trailer beneath the cooling tower at the Georgia Tech reactor.

Lake would have been glad to stay in school forever, he noted recently, but it didn't pay well enough. So, in 1973, after cranking out a 300-page thesis (a hangover from his Hanover days when he earned 50 cents per page writing term papers) and earning a master's degree and a Ph.D. in nuclear engineering from Georgia Tech, he accepted a job as a nuclear design engineer at Westinghouse Nuclear Fuels Division. At his first job, he was helping develop reload core design parameters and investigating heavy isotope buildup in burned PWR fuels. By the end of the year he would be assigned to a project seen by its backers as critical to the closure of the fuel cycle, the next step in the development of nuclear power.

Making his mark

The nation's first demonstration liquid-metal fast breeder reactor was to be built on a 1360-acre tract on the Clinch River near Oak Ridge, Tenn., the AEC announced in January 1972. By "breeding" more fissionable fuel than it consumed, the reactor was to become the technological guarantor of clean, economical nuclear-generated electric power far into the future. The project's beleaguered existence notwithstanding (it would become embroiled in partisan political debate and ideological controversy, and was finally canceled in 1983) it was where Lake would make his first mark on his chosen profession.

At one of the project's most critical junctures, design constraints appeared to have doomed the project. Congressional authorizations required a breeding ratio of at least 1.2, and the project was to use Fast Flux Test Facility–type fuel pins and was required to have an acceptable safety envelope, even under the most bizarre accident scenarios. It was determined, using the conventional design practices of the day, that a higher fuel density would be required in the core. That appeared to mean an advanced fuel design would have to be developed at a huge additional cost. (Even the birth of Lake's two sons, James and Matt, didn't help the claims of his personal contributions to the "breeding ratio.")

The Westinghouse design team—on which Lake played a lead role—began to rethink the core design. Their radical solution was to use a core design that had been cast out of consideration for more than a decade. A heterogeneous core, in which the fuel and blanket subassemblies were mixed within the core boundary, would lead to an effective increase in the core fuel density and result in a dramatic boost in the breeding ratio, as well as mitigation of the positive reactivity component of the sodium void (the LMFBR equivalent of the loss-of-coolant accident). The project lived.

1987: Lake with his two sons James and Matt (left to right) at Zion National Park in southern Utah

"[Lake's] strong technical leadership was instrumental in demonstrating the technical advantages of changing the CRBR core design from a homogeneous core layout to the superior heterogeneous layout," Richard Disney, who was manager of a peer engineering and analysis group for the Clinch River project, stated in 1992.

Lake recognized that conventional design methods could not meet all the requirements for an NRC-licensed facility like Clinch River because of his previous work in developing a systematic approach of applying uncertainties to reactor design.

Conventional fast reactor design calculations at the time were modified to take into account known systematic limitations of the nu-

1992: The Idaho Local Section is awarded an ANS Meritorious Award—(left to right) Chuck Rice, former ANS President Bob Long, Lake (the Section's chair at the time the award was given), and Harold McFarlane.

clear data and analysis methods by multiplying by the ratio of a mockup critical experiment result to an analytical result calculated for the experiment. While this approach worked reasonably well for some integral physics parameters, it had the inherent deficiency of not being able to produce a good estimate of the uncertainty in certain adjusted design parameters. This was particularly a problem for important safety parameters like the sodium void reactivity.

Working with scientists from the Argonne National Laboratory–West's Zero Power Plutonium Reactor critical experiments facility, Lake developed a technique for the Clinch River project that used not only the detailed mockup experimental data, but also all of the other relevant fast reactor critical experiment data. His technique assumed that the error in a calculated design parameter was due to a systematic component and an uncertain component, both of which could be derived from an adequately large integral data base of experiments and calculations. This technique was accepted not only by his colleagues at Westinghouse, but also by the fast reactor community nationwide.

Technical manager

In 1984, a year after the Senate had driven the final nail into the coffin of the Clinch River project, Jim Lake was notified by one of his former bosses that a management position had opened up at INEEL. The job would mean leaving technical work on a day-to-day basis to take up the next stage of his career as a technical manager.

"It was obvious that his strength was in technical management," Paul Dickson, who recommended Lake for the position at INEEL, said about him. "I regularly discussed [with his manager at Westinghouse], at least yearly, his potential for promotion to a management position. . . . We always agreed that he should be promoted to management at the first opportunity. Unfortunately, no such opportunities were available within Westinghouse."

Certainly INEEL, which was founded in 1949 to provide an isolated location where various kinds of nuclear reactors could be built and tested, was attractive to Lake. Three of the nation's commercial power reactor designs—the pressurized water reactor, the boiling water reactor, and the liquid metal–cooled breeder reactor—were first demonstrated at INEEL. In all, 52 test reactors were constructed at the lab.

"I found myself in reactor design *heaven,*" Lake said of joining INEEL. "That was, in my estimation, one of the very few labs that had a very complete, in-place infrastructure of people who had designed these reactors and built them and tested them."

Lake joined INEEL in November 1984 as manager of the Reactor Physics Branch, a technical matrix organization responsible for reactor physics and radiation transport analysis, shielding, nuclear criticality safety analysis, fuel management and core safety assurance for INEEL test reactors, and neutronic codes and methods development.

"This was a very natural step for me because I stepped into a position where I was managing the same kind of work that I knew very well myself," Lake said. "I could pretty much do most of the calculations, and I could certainly understand all of what was being done in the codes. So, it was a nice easy transition for me."

One of his first assignments was to put together a cross-disciplinary team of people to examine whether they could design a new research reactor that could operate at the ultra high-flux levels that were needed to reach the next level of materials research. The team conceived of a new kind of reactor core that had a split thermal hydraulic design ("so it looked a little bit like two doughnuts above one another," Lake said) with a hydraulic mixing area in between the two halves that suppressed the limiting fuel and constant temperature. The unique design eventually became the prototype for the Advanced Neutron Source, once slated to be built at Oak Ridge National Laboratory and once considered to be the next major research reactor in the country. The high-flux reactor was to provide 10 to 20 times more neutrons than the best source of research neutrons from a reactor.

The methods and data used in the physics and neutronics analysis of the Advanced Neutron Source were considered to be among the most sophisticated ever used in the design development of a research reactor. Monte Carlo codes were incorporated into design and fuel cycle analyses for unusual computational accuracy, and the cross-section data were developed from the most recent evaluations around the world. (Unfortunately, the project was terminated in 1996 due to the unacceptably large estimated project cost.)

Lake's technical management skills were soon recognized by his entire chain of command. In less than two years of working at INEEL he was promoted to manager of the nuclear engineering group.

"When he was promoted, I told him that I would never have suggested he uproot from Westinghouse and Pittsburgh to move to Idaho for only a first-level management job," Dickson later stated. "But I did so only because I knew that once he was in management, he would rise rapidly. Nevertheless, I


1996: Lake and his wife Sharon at the ceremony for his induction into the Georgia Tech Academy of Distinguished Engineering Alumni

admitted that this promotion was faster than I expected."

His group continued reactor core conceptual design for space power and propulsion and provided support in reactor physics and radiation transport, shielding, criticality safety, fuel management, and core safety analysis for test reactors.

Through a series of position changes with ever increasing responsibility at INEEL, Lake was named research and development director for the entire Advanced Nuclear Energy organization at INEEL. With more than 250 people, his department conducted $20–$30-million worth of R&D programs for the Nuclear Regulatory Commission, the Department of Energy, and other industrial and international customers.

"What I found was, as a manager I've expanded my ability to do things through larger, multidisciplinary teams," Lake said. "Whereas before I think I could do a pretty nice job on reactor physics, but reactor physics was only a part of the big picture. And now I can deal with the entire picture and I can bring people together. And I absolutely love the fact that teams like this can work well together and produce breakthrough ideas, and I can help them succeed."

Lake's proudest accomplishment while head of Advanced Nuclear Energy Products was his role in the DOE's designating INEEL as a lead laboratory, along with Argonne National Laboratory, for nuclear reactor technology. "The INEEL and Argonne designation as lead labs is a good use of existing capabilities and facilities to support the Department's position," said Bev Cook, DOE-Idaho Operations manager. "We're excited about the opportunities to contribute to one of the DOE's priorities—assuring clean, economical sources of power for this country."

An important contribution of INEEL will be in exploring future nuclear power options in advanced reactor design and high-performance fuel development. INEEL is already exploring these areas with universities, as well as in partnership with other DOE laboratories and agencies. For example, INEEL and ANL are investigating a next generation of nuclear fuels through the Idaho Center for Fuel Development and Testing. These would allow commercial power plants to use nuclear fuel for longer periods before replacing it, making the spent fuel more proliferation-resistant and producing less waste per unit of fuel. With the Massachusetts Institute of Technology, INEEL is investigating fuels made from materials other than uranium, such as thorium. They are also looking into multipurpose nuclear reactors—advanced reactors that would produce commercial power more efficiently and more cheaply as well as yield a second product such as process heat or isotopes.

"It's an opportunity to apply new technologies and ideas to old problems," Lake said. "The lead lab role gives us the responsibility to identify and bring together the expertise to deal with these issues. . . . The best researchers follow the most interesting research. This [lead lab designation] will help DOE create interesting and key research. For us, it's going to be exciting being a part of the next generation of nuclear reactor technology—what [director of the DOE's Office of Nuclear Energy, Science, and Technology] Bill Magwood calls 'Generation IV.'"

Lake said the future of nuclear energy goes beyond commercial power production, and INEEL sees itself as a key player in this work. The laboratory can contribute to nuclear propulsion and power systems for space exploration, he said. "Nuclear power and propulsion are 'enabling technologies' that make exploration of Mars and beyond possible," Lake said. He also noted that the DOE needs to maintain its depth-of-core competencies in nuclear energy to ensure that it can meet national needs, and INEEL "feels responsible for stewardship of a large part of DOE's nuclear energy technology capability."

Lake recently stepped aside from his position in Advanced Nuclear Energy Products at INEEL and was named director of Strategic Nuclear Business, a move designed to let him devote most of his energy to the ANS presidency.

ANS president

Besides hoping to survive the radiation dose he'll accumulate from flying around the world, Jim Lake joked, he hopes to spend his one-year term as ANS president building on the legacies of his predecessors while helping revitalize some elements of the society.

Continued

"My vision is that ANS will play a critical technical and professional role in providing the forum for technical presentations, rational and factual debate, mutual discovery, and peer validation, as well as for communicating with the public and with our political and government leaders about nuclear power and technology issues. ANS will continue to provide and increase personal value to our members.

"This role as ANS president is really not some honorary position," Lake said. "It's really nothing more than an opportunity to work and to perform. It's an opportunity for me to try to pay back the society that has meant so much to my professional career and help it do what I think it needs to do to make a difference for the future."

Renewing the society's commitment to 1997's Strategic Plan is one area Lake would like to focus on, especially as few board members remain from the board that developed the original plan. "The goals that we laid out and the vision that we articulated is as good today as it was then. Of the tactics and the strategies for achieving those, some have been successful and some have not. And that's probably a more important place to put our focus, in how we go forward and make these work."

Lake is committed to the ANS Washington, D.C., office and plans to utilize it even more to ensure legislators and national decision-makers are aware of the technical facts about nuclear technology. "Certainly, the activity that we're undertaking with Congress and government to have ANS present itself and bring the facts forward on nuclear—that's a very important role to continue."

Reinvigorating the ANS divisions and local sections is another one of Lake's objectives. Lake has been a fan of local sections since his days as a student at Georgia Tech. He was, in fact, drawn into ANS through the Atlanta Local Section. As a student, he was especially attracted to the section's policy of footing the bill for students who would attend its dinner meetings. "It's not surprising to me when we're successful attracting students with pizza parties and things like that. It certainly worked for me." (In more ways than one: Lake credits being able to bring along his girlfriend Sharon—who would later become his wife of 30 years—with assisting his courtship. "Those meetings were in some of the nicest restaurants we ever went to. Oh, I was hooked.")

1999: Lake, Kadak, and an unidentified person (left to right) at the pebble bed reactor fuel manufacturing plant in Beijing

1999: A delegation from ANS visits two Idaho senators—(left to right) Sen. Mike Crapo (R., Idaho), Bobby Seidel, Mary Lou Gougar, Lake, and Sen. Larry Craig (R., Idaho).

1999: Visiting Calvert Cliffs nuclear power plant: (left to right) Kadak; Melanie Kenderdine, senior policy advisor to the Energy Secretary; Lake; and Betsy Connell, senior advisor to the Director of the DOE Office of Nuclear Energy, Science and Technology

"We need to reinvent our local sections," Lake commented. "The energy to do that does not appear to be there. I need to think of a way to work with the Local Sections Committee and see if we can get them to help us add value for our members. . . .

"I don't fundamentally believe I can force changes on a volunteer society. For example, if a group of people wants to have a division, and it's healthy and it's functional and it's serving needs as part of the society, that's great," Lake continued. "I don't want to eliminate small divisions. But, I want to put together the coalitions and develop the consensus and the energy that is going to enable us to step up to the larger systematic issues and move forward with national agendas."

Lake also finds local sections especially important because working for them has helped him develop the particular kinds of leadership skills one needs to direct an all-volunteer organization, "where you have no clout or leverage or control over anyone."

Lake will draw upon those same skills as he tackles what he considers the biggest challenge of his term, which is motivating people to change and improve the society. "We have a saying in Idaho that the only trout that swims with the current is a dead trout," Lake said. "You really can't continue doing what you've been doing during the moribund days for nuclear and expect things to get better. The opportunities right now are enormous. The chance for us to make a real difference in the next five years has not been better in the last 25 years. We have to seize that opportunity and respond to the challenges. My job is going to be pulling people together that want to work to do that and help them to do it." NN