Michaele "Mikey" Brady Raap: An agent for change

By Susan Gallier

The 60th president of the American Nuclear Society is a criticality safety expert who tackles difficult problems with determination.

Mikey Brady Raap has come a long way. Once a girl growing up in rural Texas, she is now president of the American Nuclear Society and a recognized expert in nuclear criticality safety working at Pacific Northwest National Laboratory. How she got there makes for a compelling story. It's a story that explains how a career in nuclear can begin with a high school English paper. A story with a touch of science fiction and a lot of science. A story of family ties and family farms and the pursuit of criticality safety in reactors, tunnels, and tanks.

Math, science, and tree climbing

Michaele C. Brady was born to Tom and Lynda Brady on December 9, 1959, on the now closed Richards-Gebaur Air Force Base near Kansas City, Mo., where her father was serving. "He was a high school athlete and went to college on a basketball scholarship, but he found that college wasn't for him, so he joined the Air Force," Brady Raap said. "I think he was in the service mostly to play sports for them."

The family, which included half-sister Sylvia (Lynda's daughter from a previous marriage), relocated to Makah Air Force Station in Neah Bay, Wash., where Brady Raap's brother, Hugh, was born. "Right after my brother was born, we moved to Germany to Sembach Air Force Base," she said.

Brady Raap attended kindergarten and first grade in Germany, but her memories of the family's time overseas are spotty. "Dad was in the supply depot, but all the pictures from there were of him playing softball," she said. Her mother worked as a cook at the base's Rod & Gun Club. "She was an excellent pastry chef," Brady Raap recalls.

When Brady Raap was six years old, her parents divorced, and her mother moved with the children to her hometown of Seymour, in north-central Texas. "If you were to draw a line between Dallas and Lubbock and bisect it, you would be right about in Seymour," she said. "There's nothing really close. Wichita Falls is about 52 miles away. By the time I was a senior in high school, that's where you had to go to see a movie."

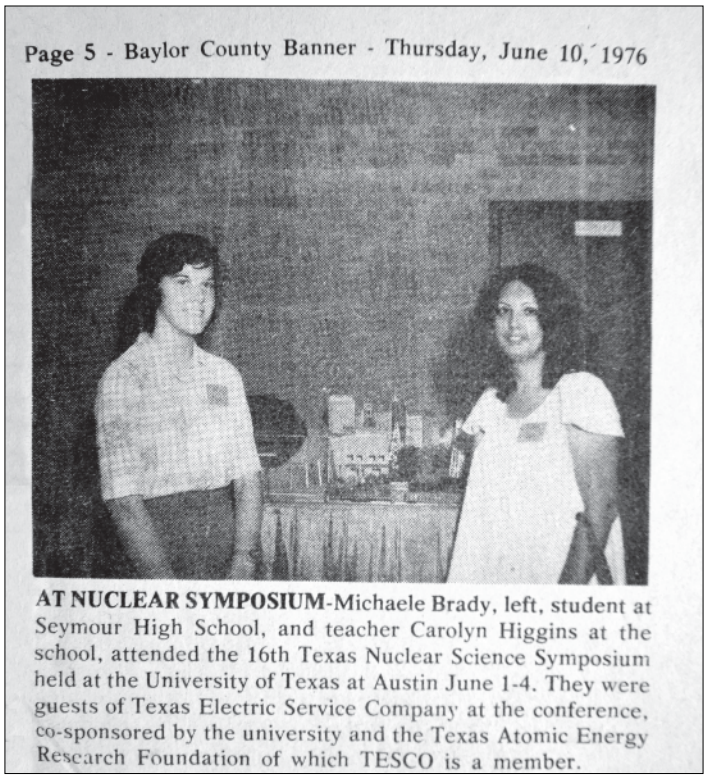
For a child, though, there was plenty to do, and Brady Raap was up for it—climbing trees, riding bikes, and participating in Girl Scouts. As a high school student she took after her father by playing varsity basketball. She also ran track, was the president of the National Honor Society and Future Teachers of America, secretary of the Business

Three-year old Michaele, far right, at Christmastime in 1962 with her parents, Lynda and Tom Brady, sister Sylvia, and baby brother Hugh.

Club, and vice president of Future Homemakers of America.

"I was mostly interested in science and math," she said. But it was a paper she wrote for English class that led to a life-altering introduction to nuclear power. "I was selected to attend a nuclear science symposium in Austin, Texas, between my junior and senior years in high school. That's where I was introduced to nuclear power. They sent me to that because I'd done a research paper in English class on nuclear power."

Brady Raap recalls that she was allowed to be creative with her paper. "I proposed making a farm planet out of Mars using nuclear technology, sort of in the futuristic sense—using a nuclear power plant to change the microclimate to get rain and to warm the ground. You didn't need a separate loop for cooling—that was built in." It was, she said, "just a kid's perspective," and one that was probably influenced by the Robert Heinlein science fiction novels she read.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AT NUCLEAR SYMPOSIUM-Michaele Brady, left, student at Seymour High School, and teacher Carolyn Higgins at the school, attended the 16th Texas Nuclear Science Symposium held at the University of Texas at Austin June 1-4. They were guests of Texas Electric Service Company at the conference, co-sponsored by the university and the Texas Atomic Energy Research Foundation of which TESCO is a member.

A photograph from the 16th Texas Nuclear Science Symposium, attended by Brady Raap (at left) and her science teacher, Carolyn Higgins, was published in the *Baylor County Banner*.

Brady Raap attended the four-day symposium, which was sponsored by the Texas Atomic Energy Research Foundation and the University of Texas at Austin, as the guest of Texas Electric Service Company. At the time, Texas Electric was building the Comanche Peak nuclear power plant near Glen Rose, Texas, together with Texas Power & Light and Dallas Power & Light. According to an article in the local newspaper, the *Baylor County Banner,* the symposium was attended "by some 500 outstanding science students and their teachers from throughout the state." At the symposium, the article continued, "scientists and engineers from universities, government laboratories, and industry will present talks on such topics as nuclear power reactors, nuclear reactor safety, the potentials of atomic energy, and future energy sources."

"The symposium helped me realize that nuclear was a reality and not just a venue for science fiction," Brady Raap said. "More than just a means to produce electricity, the idea of converting mass to energy and understanding how to control the chain reaction was kind of heady. It took me another year or so to start to think that a girl from small-town Texas might be able to do this."

As a teenager, Brady Raap had planned to be a high school teacher—math and science, of course. "And then I took the SATs," she said. "By that time, between filling out paperwork for scholarships and taking all sorts of tests, I decided that going to college was really hard work. And that if I was going to do this much work, I was going to study something that I thought was interesting." A form on the SAT listed possible courses of study. "I looked at the list, and the only nuclear thing on it was nuclear engineering," she said. "I had no idea what a nuclear engineer was, but I thought, 'Hey, it's in nuclear and that stuff is pretty cool.' And the high school counselor knew that the only school in Texas that offered a nuclear engineering degree was Texas A&M University."

A student researcher

Brady Raap headed to Texas A&M in 1977 and remained there until 1984. "Rather than go to different universities, I just let the university programs evolve around me," she said, explaining that each of her three degrees was earned during a different department chair's tenure. She earned a bachelor's degree in nuclear engineering in 1981 and a master's degree in 1982. She began her doctoral studies, and in 1984 went to Los Alamos National Laboratory on a three-year Department of Energy fellowship. At Los Alamos, she investigated fundamental nuclear decay data. "I specifically focused on fission products whose subsequent decay resulted in the emission of delayed neutrons," she said.

"Most people do their research at a university, but I was actually at the lab. When my three-year fellowship ran its course, my research was, by definition, finished. I didn't actually write the dissertation and get the degree until I was already working at Oak Ridge. I did it the hard way—I tried to do my job and the dissertation at the same time. Not recommended." Nonetheless, she did the job and did it well, and she received her Ph.D. in 1988.

It was at Texas A&M and Los Alamos that Brady Raap first participated in ANS activities. She was a member of the Texas A&M Student Section and served as treasurer for a student conference held at the university. "Then when I got to Los Alamos, my mentor there, Talmage England, was very big on ANS meetings and ANS standards," she said. Brady Raap worked with England and Bill Wilson on fission yields and delayed neutron data. "We wrote a lot of papers, and they would send me to give the presentations," Brady Raap said. "Then I got involved in the Reactor Physics Division and went to the standards meetings as well.

"Even before I started my first job, I worked with Tal to propose new standards on fission yields and delayed neutrons," she said. Brady Raap currently chairs a working group for one of those two proposed standards, ANS-19.9, *Delayed Neutron Parameters for Light Water Reactors.*

Brady Raap joined England and Wilson to work on ANS-5.1, *Decay Heat Power in Light Water Reactors.* She became a member of the ANS-5.1 Working Group and chaired the group as it developed the 2005 revision of the standard. She was asked to join ANS-19, ANS's subcommittee for reactor physics standards, and as chair of the ANS-19.9 Working Group, she remains an *ex officio* member of that subcommittee.

Brady Raap now serves on the ANS Standards Committee's Safety and Radiological Analyses Consensus Committee and on working groups for ANS-19.8, *Fission Product Yields for ^{235}U, ^{238}U, and ^{239}Pu* (a proposed new standard); ANS-8.27, *Burnup Credit for LWR Fuel* (a revision of the 2008 standard); and ANS-8.28, *Administrative Practices for the Use of Non-Destructive Assay Measurements for Nuclear Criticality Safety* (a proposed new standard).

Building a career

Brady Raap took her first professional position at Oak Ridge National Laboratory in 1987. "I was a technical staff member and made the transition from nuclear data to software applications," she said. At Los Alamos, she had worked on nuclear data related to fission and decay. It was at Oak

Ridge that she began to work in the field of criticality safety, investigating how keeping fuel in a reactor longer depletes it, making it less susceptible to initiating a chain reaction after it has been removed. "I worked in a group that produced a computer program called SCALE that has both depletion and criticality safety modules in it," she said.

Brady Raap worked at Oak Ridge until 1992, by which time she had become a senior technical staff member. She then headed to Sandia National Laboratories, where she spent two years as a technical program manager. In 1994, she relocated to Las Vegas, still in the employ of Sandia, as technical program manager for the lab's activities in support of Yucca Mountain, which were carried out by about 50 staff members in Albuquerque and another 10 in Las Vegas.

"Our team monitored tunnel stability as the tunnel boring machine dug the main tunnel. We analyzed core samples from drilling, designed tests and developed predictive models for the impact of heat on repository performance—hydrology and fracture mechanics—and analyzed total system performance for compliance with regulatory requirements," she explained.

By 1997, Brady Raap was ready for a change. "I'd been in the DOE system, including my dissertation at Los Alamos and then Oak Ridge and Sandia, for 13 years. I felt that if I could get out into the private sector, I would be able to push through more and be more results oriented," she said.

She left the national labs for a job with Duke Engineering & Services as a technical systems manager. Her first assignment with Duke was at the tank farms on the Hanford Site, near Richland, Wash., where she was in charge of safety engineering issues, including criticality safety and authorization basis implementation. "The plan was that Hanford was my first assignment because of an immediate need there for which I was well suited," Brady Raap said. "The expectation was that there would be a next assignment. Then I met my husband there in 1998, and that meant I was going to stay. So now I'm committed to this area."

The newlyweds at their wedding reception in June 1998.

She had met Dan Raap, a widower with two young daughters, Kimberly, 10, and Kathleen, four, nicknamed Kimmie and Katie. "Our romance was a whirlwind. We met in February and were married in June. Our son, Justin, was born as a first anniversary gift in June 1999."

In 2000, daughter Katie (bottom right), who was born on Halloween, celebrated her seventh birthday in costume with (from left) Kimmie, 13, Justin, 16 months, and Brady Raap.

Dan was working for Fluor Daniel Hanford, the principal contractor at the Hanford Site, in the office that managed the prime contract between Fluor and the DOE. "He basically managed the terms and conditions of the contract between Fluor Daniel and the Department of Energy," Brady Raap said. "One of the things he did was help set up a memorandum of understanding between Fluor and Pacific Northwest National Laboratory, which is located at the Hanford Site, before I began working there."

Because she was committed to staying in the area, Brady Raap sought a more permanent position, and in December 1999, she was hired at PNNL as a project manager. "They hired me specifically to do criticality safety for the design of the Pit Disassembly and Conversion Facility, which was part of the Plutonium Disposition Program in the U.S.," she said. "It was part of the Russian/U.S. treaty for both countries to convert a certain quantity of weapons-grade plutonium for use in commercial mixed-oxide fuel."

After the DOE stopped work on the Pit Disassembly and Conversion Facility about 10 years later, Brady Raap became the team lead for nuclear safety in PNNL's National Security Directorate. "Now my work is pretty diverse," she said. "My biggest project right now is the Waste Treatment Plant [WTP], the vitrification facility being constructed at the Hanford Site. I'm the senior technical advisor to the principal vice president, working to develop a strategy to resolve criticality safety concerns about the facility."

She has been working on issues related to remediation at Japan's Fukushima Daiichi nuclear site, and is also involved in projects under the National Technical Nuclear Forensics Center to look at pre-detonation

signatures from reactor materials, which she describes as "very interesting work." She and her team are studying the isotopic content of irradiated fuels to see whether there are specific characteristics that could help identify the type of reactor that may have produced fissionable material collected with the intent to develop a weapon.

Brady Raap was named to the DOE's Criticality Safety Support Group in 2012. "This is a group of about 12 criticality safety experts that provides operational and technical expertise to the DOE," she said. "In 2012, then Secretary of Energy Steven Chu created a team to review safety issues at WTP that were delaying the project. I was on a subgroup of that review team formed specifically to look at criticality safety at WTP."

Brady Raap's current title is nearly as lengthy as a list of her achievements. She is a chief engineer with the Nuclear Engineering and Analysis Department within the National Security Division at Pacific Northwest National Laboratory.

Involvement in ANS

"I've been deeply involved in ANS for a long time," Brady Raap said. "Soon after I started making presentations, I started working on the Program Committee for the Reactor Physics Division, and then from there I went through the officer ranks. I went through all the officer positions for the Reactor Physics Division, including the chairmanship." After she got her first job at Oak Ridge, Brady Raap became involved in the Criticality Safety Division. "In that division, I participated in and am still a member of their Education Committee. I was on their Executive Committee and chaired that division as well," she said.

She was elected to the Board of Directors twice, in 1998 and 2006, and served three terms on the Finance Committee before becoming ANS treasurer in 2011. She has been vice chair and chair of the Professional Divisions Committee and vice chair of the National Program Committee and has served on the Publications Steering Committee and its Meetings Proceedings and Transactions Subcommittee.

Because of her two years of service as treasurer, Brady Raap has been a member of ANS's Executive Committee for three years now, and she decided to run for president with full knowledge of the challenges involved. "A lot of things were changing in the Society, and to borrow a phrase from former president Tom Sanders, I wanted to make the Society more relevant," she said. "I was also concerned about making ANS more operationally efficient. There were some changes that I thought we needed to make, and we needed the leadership to be able to move forward. I think the key to making us more relevant is being responsive and being more agile and just stepping up our game in how we communicate internally and externally."

At Texas A&M in September 2013 to celebrate the Nuclear Engineering Department's 55th anniversary, Dan, Justin, and Katie were able to catch Johnny Manziel in action versus Sam Houston State.

Brady Raap points to developments made in the Society's operations and image under ANS's past three presidents—Eric Loewen, Michael Corradini, and Donald Hoffman—and sees an opportunity for more change. "ANS was moving in a positive direction, and I felt like I could carry that forward," she said.

"I thought that my depth of experience in the Society and my knowledge of how we operate in our financial system—which is one of the things we need to upgrade—would be beneficial," she continued. "Most of the jobs I've had have been as a 'change agent,' so I'm comfortable in this role. I take on the hard problems. I guess they appeal to my inner Pollyanna or Don Quixote. I do them because I can make a difference and they're important."

Brady Raap is the third woman to hold the office of ANS president. But she prefers to focus on the job to be done, not gender. "I think that the whole 'woman' thing was over-emphasized," she said. Her presidency still qualifies as a "first," however. "I'm the first ANS woman president not to be named Gail!" she said. "There were two very impressive women before me—Gail de Planque [1988–1989] and Gail Marcus [2001–2002]."

Since joining ANS in 1986, Brady Raap has witnessed an increase in the number of women in ANS. (In 1986, about 4 percent of ANS members were women; currently, about 10 percent of the members are women.) When she began giving presentations at meetings as a young graduate student, "people were clearly expecting a male to stand up," she said. The fact that she goes by Mikey may have helped to confound expectations. "My name is very confusing for people," she said. "My formal name is pronounced like the more familiar Michelle, but it's spelled like Michael with an 'e' at the end, which is where 'Mikey' comes from.

"There are clearly some challenges that are specific to being a woman in nuclear," she said. "They're changing a little bit—gradually. I think the real difference I see is within ANS as an organization. There are a lot more women in leadership positions than there used to be. Look at the number of women on our Board of Directors, for instance. Nine of the 20 current board members are women."

Farm and family

Brady Raap and her husband, Dan, live just outside the small town of Benton City, Wash., which is about halfway between Richland and the Raap family farm near the town of Prosser. "Dan's dad farmed there for over 50 years," she said. "They had grown all kinds of things, from sugar beets to potatoes. Then about 30 years ago, they went from field crops to orchards. Now the farm produces pears, Fuji apples, Bing cherries, and apricots.

"One orchard has three rental properties," Brady Raap said. "My father lived in one of them and helped out with the Fuji apples and with the other renters for about the last 10 years of his life. My mother, too, came from Texas to live in Washington state during the last four years of her life. She got to be a grandmother to her grandchildren, and I think that turned out pretty well for all of us. She passed away in 2003.

"My husband's parents were divorced also, and at one time, all four parents, in various states of health, were living within a 60-mile radius," Brady Raap said. "We were caretakers for all four of them, so for a while we were going between their four houses. We also had three children, careers, and rental properties. It was an interesting few years."

Since his father passed away in 2009, Dan, who retired in 2010, has been running the farm, which is known as Triple R Ranches, as well as a separate Fuji apple orchard, and managing a collection of rental houses he acquired over the years. Some land on the farm is leased for growing hops and wine grapes. "And we run about 25 head of cattle out there for fun," Brady Raap said.

For several years, Brady Raap handled the payroll for cherry picking and similar jobs on the farm. "I transitioned all the books over to Quickbooks," she said. "Now that my husband is retired from his Hanford job, he's gotten to where he can do a lot of that himself, but I still pitch in for payroll at harvest time."

"My other 'hobby' is my grandchildren," she said. "My daughter Kimberly is married and has two children, Tyler, who is six years old, and Chelsie, who is two. We just taught Tyler how to ride his bike without the training wheels—he learned that at Nana's house with Papa." Katie, who is now 20, attends junior college, and Justin, 15, just finished his freshman year of high school.

Brady Raap, who began her presidential term in June at the close of the 2014 ANS Annual Meeting, may be firmly rooted in eastern Washington with her family, but she still has the same drive that got her from rural Texas to where she is today—an accomplished engineer and manager. Every day, and in every job she takes on, she's working on the difficult problems and making a difference. And she intends to do the same as president of the American Nuclear Society. NN

Grandkids Chelsie and Tyler play with "Nana" on an old tractor at Triple R Ranches, the family farm. The poles in the background are for growing hops.

Tyler and Nana fish at the farm as some of the herd of 25 cattle graze nearby.