The Nuclear Odyssey

of

Dr. John E. Gunning

as relayed to

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the American Nuclear Society 2023-24

The first generation of scientists and engineers who began our nuclear world, such as Fermi, Oppenheimer, and Feinman are now long gone. These men were born in 1900, 1904, and 1918 respectively. Given that it is more than 100 years since the youngest of these was born, this generation's story has been told.

A more recent generation was born in approximately 1950 and would have been graduating when nuclear power plants were beginning to supply power to the electrical grid.

With this background, I am working to obtain the career journey of a number of these more recent but 'aging' nuclear engineers. The individuals who were born in ~1950 are now about 75 years old, and thus it is good to obtain their stories soon while they are still around. I believe that these stories will be of interest to the generation of nuclear engineers who are now (~2024) graduating from college and born in approximately 2000.

The initial narrative is from Dr. John E. Gunning. I ran into him at an ANS Oak Ridge/Knoxville Local Section event in the fall of 2023 at the High Wire Brewery in Knoxville. John relayed that he retired about ten years ago (end of 2013), and I asked him what he had done during his career. He told a very interesting story that had amazing diversity, although almost all within the realm of nuclear science and engineering. Thus, we begin his Odyssey.

John grew up near Dayton Ohio and he graduated from Tecumseh High School. The first paper describing the structure of DNA was recently published and this created much excitement with many publications on the subject during the following years. Thus, for a science project he built, with his father's help, a 3' model of a DNA molecule. He subsequently enrolled in the Engineering School at the University of Michigan (UM). Folks sometimes ask why he went to UM if he was from Ohio. He replies – one has no choice of their birth location, but one is able to choose a great school.

As a sophomore, students made an initial choice of a major. He chose electrical engineering, but after a semester of this he realized that this was not his calling, so he jumped from the frying pan into the fire by changing to nuclear engineering. He did not realize it at time, but John was in the first class to graduate from UM with an undergraduate degree in nuclear engineering.

During the summers he would return home and hit the streets looking for summer employment. These included a company that made most of the parts for Air Stream Trailers, a survey crew

rodman, and an assistant at Defense Electronics Supply Center at Wright Patterson Air Force Base.

But the interesting one related to his career was as a maintenance assistant in an old 60-megawatt electric (MWe) coal fired power plant in Springfield Ohio. This plant was originally built in 1927 as a 20 MWe power plant, with 20 MWe added in 1939, and another 20 in 1950. The original 20 MWe turbine took two boilers to power it, with lump coal coming down a chute and transported into the boilers by Archemedes Screws. The 'newer' boilers used powered coal that was injected into the boilers. The official site for this plant (https://abandonedonline.net/location/mad-river-power-plant/) says that it was three units of 20 MWe, but he recalled when (infrequently) running at full load the whole plant shook and it put out close to 75 MWe. So, John's early employment was at a power plant that was initially built almost 100 years ago!

John had an enjoyable and rewarding experience in UM's Nuclear Engineering Department. Part time work at the University included –

- Shooting a pulsed ruby laser from a building on UM's north campus to a corner cube (reflective mirror) on the top of a university building on the main campus, about 1 ½ miles away, and return. They measured the speed of light and confirmed earlier measurements were correct. Current regulations would likely prohibit shooting this relatively high-powered laser in an unrestricted path about town. The first laser operated in 1960, thus he felt like Forest Gump being in the middle of science history.
- Using a laser interferometer to measure the density of a pulsed plasma.
- Assisting in the development of gamma ray imaging techniques using synthetic apertures in the Nuclear Medicine Unit of Michigan's University Hospital.

After four years John was near graduating in 1969 but did not have quite enough credits. This was relatively common with the required coursework in the Engineering School. The year after his senior year he worked for Atomic Power Development Associates (APDA) in Detroit Michigan, commuting by train from Ann Arbor to the Michigan Central Train Station. He would then walk about 1 ½ miles down Michigan Avenue to the Michigan Theater Building near Grand River Avenue. This path crossed 12th Street (now Rosa Parks Blvd) which had been the site of major riots two years before in 1967, which John frequented on his lunch breaks. APDA was the developer of the first power producing liquid metal (sodium) fast breeder reactor (LMFBR) in the US. During the time there, John coauthored an American Nuclear Society (ANS) paper on the cleanup of this reactor following the melting of a fuel element in 1966. John recently was at the November 2023 ANS meeting where he went to presentation of 'advanced reactors' which included an LMFBR. After the talk John mentioned to the author that he worked on one of these 54 years earlier!

John had some outstanding professors during his nuclear engineering education. These included Dr. Chiro Kikuchi who was a developer of the maser, which preceded the laser. Dr. Kiuchi had on his wall a crystal that had been temporarily borrowed from him for use in the first ruby maser.

John had a course on nuclear instruments and methods for Dr. Glenn Knoll. Many students have heard their professors complain about the textbooks that were available for their course and

threatened to write their own. In this case, Glenn subsequently did write his own textbook, *Radiation Detection and Measurement*, which was published in 1979 and has been the gold standard on this subject for many years.

Dr. James Duderstadt was a member of the Nuclear Engineering department and later become President of the University of Michigan, from 1988 to 1996.

John graduated with a BS in Nuclear Engineering (NE) in December 1969. He then was accepted to graduate school and completed his MS in NE in 1971, at which time he had had enough scholastic pursuits for a while. So, he bought his boots and intended to hitchhike west. However, the ads in the Michigan Dailey included a note from a chap looking for a traveling companion to Europe. Hmmm. East, west. Whatever. After meeting at Ann Arbor's Del Rio (a pub) to confirm the solicitor was not a teetotaler, they hit it off and subsequently drove John's TR-3 to his parents in Dayton Ohio, hitchhiked to New York, and boarded an airplane to London. This adventure was an amazing four months, going to England, Ireland, most of Europe, including Navik which is 8 degrees (about 500 miles) north of the Artic Circle. However, most of this part of his Odyssey is not related to nuclear issues, so we will jump over the rest of it.

On his return he began working as an assistant in the NE department on the measurement of plutonium's neutrons per fission (nu), got married the following June, drove west to Canadian Rockies for his honeymoon, toured Jasper, Banff, stayed at the Chateau Lake Louise, and backpacked for four days in The Valley of the Ten Peaks. He returned to work in the same NE lab and applied for the PhD program. After he passed his prelims and was admitted to the PhD program, Dr. John (aka Jack) M. Carpenter became his advisor, and John G performed research on neutron scattering, and managed a neutron beam port at the UM's Ford Nuclear Reactor.

The beam port permitted a continuous beam of neutrons to stream from the reactor core, which was then 'chopped' by two rotating disks with a hole through the diameter of each. This created a short pulse of neurons with a continuous range of energies. The higher the energy, the faster the neutron travels, and hence the sooner it gets to the sample target and subsequently a neutron detector. By using detectors that separated the earlier arriving neurons from the later ones, useful information could be obtained about the sample being investigated. Dr. Carpenter realized that a pulse of neutrons could also be created by directing a pulse of high energy protons at a heavy metal such as iron or lead. The metal atoms would then break apart (spallate) and in the process emit copious neutrons, approximately 13 or more neutrons per proton. Jack began working with Argonne National Lab on the development of such a source. Later Jack gave up his full professorship at UM and moved to Argonne to develop this neutron source.

So, how is this related to John's Odyssey through nuclear engineering? Recall Jack was John's thesis advisor, and John was part way through this PhD program. What does a student do when his thesis advisor picks up and leaves? He usually follows him. Thus, John went for Argonne in about 1975 where he pursued his thesis – *The Structure of Amorphous Arsenic as Determined by Thermal Neutron Scattering* as well as worked with Jack and the Argonne staff on the development of the first proton pulsed neutron source, called ZING. The Z is from the Z in Zero Gradient Synchrotron (ZGS), and ING for intense neutron generator. ZGS had been a source of

high energy protons used in high energy physics experiments. However, the energy needed for high energy physics had significantly increased and Fermi Lab was built in Batavia Illinois to satisfy the need. ZGS consisted of a circular ring with a diameter of perhaps 500' for accumulating protons and a linear accelerator (linac) for injecting the 12 GeV protons into this ring. After Femi Lab was built, ZGS was no longer needed, and the 12 GeV proton linac was adapted for use as the first proton pulsed neutron source. ZING subsequently evolved into the Intense Pulsed Neutron Source (IPNS), and in 2006 the Spallation Neutron Source (SNS) at Oak Ridge National Lab. Jack once reminded John that his thesis was the first one that used a proton pulsed neutron source to obtain the data. In addition, John was one of the coauthors on the first paper on neutron scattering experiments using a proton pulsed neutron source.

John was at Argonne from about 1975 until he received his PhD in March of 1978. While at Argonne he commuted approximately weekly from Ann Arbor (AA) where he and his wife Susan had a home. She was a violinist and taught orchestra in the Ann Arbor Public Schools as well as performed with the Ann Arbor Symphony Orchestra. During their Odyssey, she also performed with the Miami/I-95 Symphony, the Palm Beach Opera, the Knoxville Symphony, the Knoxville Symphony and the Oak Ridge Symphony.

While at Argonne John found that there were numerous academics who obtained short term appointments there with many of them being quite brilliant but were having a difficult time finding a tenured university position. Thus, when John finally got his PhD, he decided against taking the academic route and joined Bechtel Power Corporation. He interviewed at the UM engineering placement center where there were three Bechtel representatives. He happened to talk to the one from the Los Angeles office with the other two being from the Ann Arbor office where Bechel also had an office. He received a 'Mail-O-Gram' the next day inviting him for an interview in Los Angeles (LA). OK. Off to LA. Then he thought he should also talk to the AA office. Bechtel generously gave him an offer with his choice of either location. He had decided if he received an offer of at least $20k, which was a lot in those days, he would accept. They seriously considered going to LA, which was quite attractive at the time, and they could have afforded a reasonable house. But they eventually decided to stay in AA, partly because they already had a house and Susan had a teaching job there.

John was employed by the Bechtel Corporation for the next 25 years.

When John joined Bechtel Power Corporation in Ann Arbor, he began working on the nuclear design and licensing of the Greenwood II and III Nuclear Power Plant (NPP). This consisted of two Pressurized Water Reactors (PWRs) of 1,200 MWe each planned for Port Huron, Michigan. The project was still in the design stage with no concrete yet poured. He worked on this project for a somewhat more than a year before it was cancelled in March of 1980. He then transferred to the Midland I and II NPP, which consisted of two B&W once through steam generator units with approximately 900 MWe equivalent each. One of the reactors had an electrical rating of 400 Mwe because a significant amount of the heat was dedicated to process steam for Dow Chemical Company. This project was well along in construction when he joined.

There was some local opposition including from anti-nuc Mary Sinclair. As part of the defense of building this NPP, John gave a stirring speech from the steps of the Michigan State Capital in Lansing with the final declaration – *Who needs Midland? MICHIGAN needs Midland!!* However, the Midland project was cancelled because the soil fill placed on the site was not adequately compacted, and some of the buildings began to settle (sink into the soil) and the associated stress cracks were created in some of the buildings. Thus, the Midland I and II project was cancelled in July 1984. It was about 85% complete, 13 years behind schedule, and 20 times over the initial cost estimate. As you can see, John was riding the slippery slope of NPP cancelations shortly after he graduated.

John was probably the only nuclear engineer in the world who did not know about the meltdown at Three Mile Island for a week after the March 28th, 1979 event. He was on a charter dive trip that flew from Detroit to Cozumel Mexico and stayed in a Mexican hotel with no English-speaking staff, newspapers, or radio. The hotel occupants were mainly from Michigan, but we were all in a time capsule isolated from the outside world. When next week's occupants arrived, one of the newbies mentioned the great nuclear accident. He had heard many times before about large accidents that were actually the leakage of a couple milliliters of tritium and was thus a skeptic. However, another person piped up, who worked for Washington Public Power Service (WooPPS) and confirmed that a real mess had been created.

The Ann Arbor office of Bechtel employed approximately 2,000 folks, working on Midland as well as other projects. One of the others was Belle River Coal Plant between Detroit and Port Huron, which was nearing completion. Thus, the combination of Belle River completion and Midland cancellation resulted in the Ann Arbor office going from approximately 2,000 to 200 in 2 weeks. A significant reduction in force. Many of these were at least temporarily unemployed. However, all the nuclear engineers found homes, with quite a few including John going to Turkey Point NPP, which is south of Miami and north of the Florida Keys. Finally, John found a NPP that was working!

During this time many NPP were making modifications to address shortcomings found because of fires in cable trays at Browns Ferry NPP (checking air leaks using candles is not a good idea) and the disaster at Three Mile Island Unit II (The reactor operator's dilemma was - bubble, bubble, where's the bubble? The operators should have just left the building so they wouldn't cause a meltdown.) He led a project analyzing and designing fixes to the reactor that could bring it to a cold shutdown condition assuming a fire consuming any single room at the NPP. Not only do you have to thoroughly understand how the plant operates and its redundant equipment functions, but you also need to know where each piece of equipment is, as well as all routes for the signal and power supply cables. An interesting project. Because these fixes addressed fires, one also had to ensure a reliable 'fire water supply.' No, not whiskey, but water that puts out fires. One of the reliable sources of fire water was a tall water tower located adjacent to the NPP. He expressed his concern about this because hurricanes are relatively common in South Florida and thought the tower might be blown over. However, he was assured that the tower had been analyzed for hurricane forces. However, subsequently (after he had left) Hurricane Andrew passed directly over the NPP. The plant shut down prior to the hurricane's arrival, but a

‘hurricane missile’ (airborne debris) hit one of the bracing wires which led to the toppling of the water tower. In retrospect, perhaps John should have been more insistent.

During John’s first year at Turkey Point he was on a temporary assignment, with Susan living in Ann Arbor. So, he shared a room with a fellow Bechtel Ann Arbor refugee in a condo on Key Largo in the Florida Keys. Two tennis courts, two pools, lots of boat slips, beautiful view, and nighttime entertainment of watching the blue lights of the Coast Guard intercepting the water born pot and coke shipments. Rough life. After Susan moved down to Florida they moved to South Miami - east of US 1 and near Coral Reef Drive (152nd Street).

At the Turkey Point site, which was down a 10-mile road through the Florida Everglades, Bechtel worked in trailers supplied by Florida Power and Light (FP&L). Bechtel had visions of also working for other clients, so they wanted their own office, and hence moved to Palm Beach Gardens, approximately 80 miles north of Miami. This office was near Juno Beach which was FP&L’s engineering office, Bechel’s actual client, not FPL construction. He continued similar work in the new location.

While working at Turkey Point, he was invited to participate in an American Nuclear Society (ANS) tour of Russian NPPs, including Chernobyl NPP. However, each participant had to pay his own way, so he applied to Bechel to sponsor the trip. The application went quite far up the chain of command but was eventually rejected. John was almost an expert on Chernobyl prior to its explosion on April 26th, 1986. Forest Gump avoided history this time.

Eventually, much of the work was finished and FP&L wanted to complete the job themselves as well as minimize the contractors they employed. So, after about 5 years working at Turkey Point NPP, it was ‘on the road’ again. This time to Brown’s Ferry NPP in Athens, Alabama. The origin of all the fixes needed to achieve cold shut down following a fire (recall searching for air leaks using candles?). Brown’s Ferry NPP consists of three units, all of which were shut down after the fires. When he arrived in 1989 the Tennessee Valley Authority (TVA) was in the process of restarting Unit II after all were shut down in 1985. He found lodging near Huntsville, Alabama, home of NASA’s Space Flight Center. But while working at Browns Ferry he strived to end his nuclear nomad existence by searching for employment other than upgrading NPPs.

Bechtel is a large enterprise that encompasses several separate companies. Bechtel Power worked on power plants, and Bechtel National performed government work. Bechtel has an office in Oak Ridge, Tennessee for which Bechtel National was performing environmental cleanup at numerous sites. He contacted the office (the head of the office happened to be an undergraduate nuclear engineering classmate of his at UM), took a vacation day to drive to Oak Ridge, had an interview, was offered a position on a Wednesday, and started the following Monday. Quick work! And relatively painless as both were Bechtel companies.

His initial work was a six-month project to perform a ‘hazardous ranking’ of the FUSRAP sites. FUSRAP stands for Formerly Utilized Site Remedial Action Plan. The cleanup of 31 sites, in 13 states, where work was performed for the Manhattan Project contributing to the atomic bomb. The hazardous ranking was done to prioritize funding for cleanup of the various sites. A very

interesting introduction to companies and sites which contributed to the development of the atomic bomb that are not commonly known.

Although much of the Oak Ridge Bechtel office was dedicated to environmental cleanup, it also had a related project developing a low-level radioactive waste (LLRW) disposal site in Butte, Nebraska, in eastern Nebraska about 7 miles south of South Dakota. The LLRW Policy Act of 1980 established that each state was responsible for the disposal of LLRW generated within its borders. As a result, states organized agreements, or compacts, with other states to develop a common disposal site, in this case for Arkansas, Kansas, Oklahoma, and Nebraska. The agreement between these states was the Central States Compact (CIC). John performed the nuclear analysis to determine the inventory of radionuclides as a function of time for the facility, as well as many other analyses. In the process he learned much about groundwater transport, partition coefficients - the ratio of nuclides attached to the soil to that in the groundwater - and clays such as bentonite which expand when wet. John wrote a paper about the facility which was published in a 1977 volume of *Radwaste Magazine*. There were two public hearings at the site on the facility, both cleverly chosen for the middle of February when it is very cold and dark, in which John testified about the analysis of a fire that occurred adjacent to the facility. John's analysis was the only one approved and the others were rejected. The project was opposed by a local group, as well as the then Governor of Nebraska, Ben Nelson, and because of unlawful interference by the governor, the project was cancelled in approximately 1994. The CIC sued and eventually in 2005 the State of Nebraska had to pay the compact participants approximately $115,000,000.

He also worked on a LLRW disposal facility proposed for a small island near Taiwan. Because the island was not large, nor far above sea level, John proposed a tunnel that went beneath the seabed, which was pursued. He had a week in Taipei during which he and his colleagues made presentations in English, which the Taiwanese easily understood. However, the remainder of the time the Taiwanese made presentations in Chinese, which he and his colleagues of course did not understand. With some difficulty John managed to survive a week of presentations that were unintelligible to him.

He next participated in the design of a NASA research facility at Marshal Spaceflight Center in Huntsville, Alabama. This involved designing many strange and diverse particles including antiparticles. This project came to an exciting end when NASA and Bechtel came to an impasse on cost. NASA expected design to be not more than 10% of construction cost, which would be appropriate for typical facilities. However, this was not a typical facility. During a scheduled review meeting between the parties in which Bechtel management was present, Bechtel picked up and walked out because it felt it could not expect to recoup its costs. Excitement!

John's next assignment was one of the most interesting in his career. However, a little background is first needed. By 1982 the number of nuclear weapons had reached the point where the US and the Soviet Union could blow each other up approximately ten times. At this time President Raegan proposed a significant reduction in these weapons to a number that more closely approaching being able to blow each other up only once. After many years of negotiations, an initial Strategic Arms Reduction Treaty (START) was signed in 1987 and the

final by President G.H.W. Bush and Secretary Gorbachev in 1991. This treaty eventually resulted in the removal of about 80% of all strategic nuclear weapons then in existence. An amazing feat!!

However, the Soviet Union collapsed at the end of 1991, which would leave the fissile material from dismantled nuclear weapons in a precarious state of security. As a result, Senators Nunn and Lugar initiated the Soviet Nuclear Threat Reduction Act of 1991. This act accomplished many worthwhile objectives, one of which assisted Russia in constructing a facility to securely store this fissile material removed from Russian nuclear weapons, the Russian Fissile Material Storage Facility (RFMSF). The US Government funded this via the Defense Threat Reduction Agency, then the US Army Corps of Army Corps of Engineers Transatlantic Division (CTEC), and then Bechtel. Bechtel then paid the Russian design and construction organizations to design and build the facility. This work was ongoing when Los Alamos National Lab (LANL) thought that they should perform a safety analysis of this facility. So, they came to Bechtel to request their cooperation. Bechel managers did not know what to do with these scientists, and not having many PhDs in nuclear engineering within their ranks, they reached out to John. Thus, began his management of the Safety Analysis of the RFMSF.

Bechtel has world class experts in seismic, soil structures, and civil structural analyses, and thus performed these, while LANL personal performed the nuclear analyses, and John did his best to keep all pointed in the same direction. During this time, he traveled to Moscow, St. Petersburg, Yekaterinburg, and Ozyorsk (Mayak) for a total of 12 trips to Russia from 1999 to 2002. Back then it was very interesting and enjoyable to travel to Russia and the people were extremely friendly and welcoming. However, the Russian people were experiencing difficult economic times because in August 1998 the Russia ruble lost 70% of its value. Thus, the value of their savings essentially evaporated. Consequently, the Russian people were selling anything they could find to survive such as Matryoshka dolls, lacquer boxes, and other crafts, as well as military goods such as uniforms and hats. John bought an authentic Russian submarine flag for $25. Most of the cities he visited had craft markets, with many of his trips being in the winter and the consequent lack of other potential purchasers. Consequently, as soon as he entered the market he was deluged with solicitors. It was difficult because he wanted to purchase some interesting products but had to try to politely say no to many of the desperate merchants.

Entering and exploring the RFMSF site was also interesting. Their vehicle would enter through a sturdy gate which closed behind and they were then in enclosed an inspection facility with armed guards pacing on a platform above. After making it past the guards, he explored the under-construction facility and was amazingly free to take pictures. An interesting feature was the small birch trees being used for interior construction supports, giving the appearance of being in a forest. Also, it was apparent that OSHA regulations are not applied in Russia, with an example being ladders to the top of buildings made of welded reinforcing bar.

During meetings with Russian counterparts in Moscow and St. Petersburg, minutes were taken that had to be approved in both English and Russian. Russian staff took the minutes in Russian and then John had the electronic files emailed to Bechel's US headquarters in Tyson's Corner Virginia, which translated them into Russian, and them emailed them back. The nine-hour time

difference between Virginia and Moscow facilitated translation during EST normal business hours, and then emailed back for John to retrieve at 3:00 am, print out, and deliver for review by both parties the next morning. This was after, of course, after a full night of exploring the cultural offerings these cities had to offer such as the Marinsky Ballet and the Bolshoi Opera. After John's approximately 20-hour travel back to the US, you might image he was extremely exhausted, both from the time difference as well as burning the candle at both ends while in Russia.

After finishing this rewarding project, he returned to Oak Ridge and became a nuclear facilities safety engineer for cleanup and remediation of facilities at Oak Ridge National Lab (ORNL) and the K-25 site in Oak Ridge. The X-10 reactor at ORNL was the first reactor to create small amounts of plutonium that were used to develop the chemistry for separating plutonium from the fission products and other material in irradiated fuel elements. This separation was performed in ORNL Building 3019, and the developed chemistry was used on the plutonium created in reactors at Hanford, Washinton and subsequently in the atomic bomb dropped on Nagasaki, Japan. This building had performed an important function but had long outlived its usefulness and was being cleaned up for eventual restoration or demolition, and John was the nuclear safety engineer who had to evaluate hazards in this building. One of the interesting attributes was the presence of perchlorates, which are chemicals that can explode if they receive an impact. There was a need to be careful here.

After a year of this relatively interesting work, John left Bechtel (after 25 years and being awarded a Rolex watch) and joined ORNL and where he worked on '*Plutonium Disposition in Russia*.' The objective was to convert 34 metric tons of US and Russian weapons grade plutonium into reactor fuel for use in conventional light water reactors, with John's project working with the Russians on the disposition of their plutonium. So, he again traveled to Russia, his time for three trips to Moscow and Tomsk (which is in Siberia). The Russians were not actually interested in converting their plutonium into reactor fuel, but worked with the US representatives as long as the US was paying them for their work. This project also had some strange political connections in the US. Shortly after a meeting with Russian representatives in Moscow in which the US side said it appeared that an impasse was reached and they had left the meeting, their cell phone began ringing as soon as they left the subway. Someone had contacted a Washington DC political representative who forwarded his umbrage at our actions. It seemed like a scene from James Bond or a Tom Clancy novel. After about three years the project was cancelled due to noncooperation by the Russians.

John continued at ORNL and began working on safeguards at centrifuge enrichment facilities. Working with LANL they researched and worked on the development of a device to monitor the flow of and enrichment of U-235 at centrifuge enrichment facilities. He named it the catchy title FEMO for flow and enrichment monitor.

His final professional pursuit was a project called the '*Second Line of Defense*.' The names comes from the security fences around Russian nuclear facilities being the first line of defense. These were not reliable after the breakup of the Soviet Union, and combined with concern for terrorists after 911, radiation monitors were placed in numerous ports and border crossings to

detect the illicit transport of enriched uranium and plutonium. These monitors were helium-3 tubes for detecting neutrons and plastic scintillators for detecting gamma rays. Many of the countries with these detectors would send the accumulated data monthly to ORNL which was evaluated by analysts to ensure proper operation of the detectors. The data consisted of detector counts as a function of time and a once daily variation was expected due to the sensitivity of the photomultipliers with temperature which were part of the detectors. However, when John was reviewing one of the data sets, he found a twice daily variation and wondered what could cause this. Given his sailing experience and familiarity with ocean properties, there might be a correlation with the tides. Further investigation confirmed this, and he wrote an ANS paper titled *The Effect of Tides on Background Radiation*. Later investigation of similar data revealed that there was also a monthly variation. The relative position of the position of the earth, sun, and moon induces a monthly cycle onto the tides. Thus, he wrote another ANS paper titled *The Effects of the Phase of the Moon on Background Radiation.* And it's real!

John retired from ORNL on December 30th, 2013, he and Susan left town on January 20th and traveled to Port Salerno, Florida (near Stuart), where they had their previously purchased a 31' trawler, a Camano 31, which he renamed *Nuclear Fishin*. They weighed anchor and left the dock on February 6th and began their Nuclear Fishin Odyssey on America's Great Loop. A 5,500-mile journey via water around the easter half of the US. But that is another story.

However, it is contained in the completed and soon to be published -

Nuclear Fishin Odyssey
A Narrative and Visual Journey Along America's Great Loop
The 5,500 Mile Water Cruise Around the Easter Half of the US
by Dr. John E. Gunning

We hope you have enjoyed this nuclear adventure as told by John to Jin Whan Bae.

February 2024
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