

THE ACORN



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**Oak Ridge/Knoxville
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A MESSAGE FROM THE CHAIR

.....Harold Denton

The Oak Ridge/Knoxville Section of the American Nuclear Society is in fine shape, both professionally and financially. You may have already heard that we received the Local Sections Meritorious Award at the June ANS National Meeting. Much of our success was due to the devotion of Larry Miller and his outstanding leadership. Mayme Crowell, outgoing Treasurer, has reported that on June 30, 1997, our assets totaled \$46,353, which could allow for new initiatives this year. Our new Treasurer, John DeClue, and I recently completed the required audit of our books and found Mayme to have been a most meticulous and organized record keeper. Our Membership Committee reports that our membership base stands at 238 out of the 622 local members of ANS National in our region. Our Topical Procurement Committee has been busy planning three forthcoming Topical meetings. Our new Program Committee Chairman, Ed Lee of ORNL, brings a new perspective and plans to schedule our monthly program meetings months in advance. Also, I want to call your attention to the fine efforts of Hanna Shapira in preparing and maintaining an outstanding Home Page.

In this era of declining federal science budgets, and especially R&D funding for nuclear technology, it is especially important that all members become "civic scientists who promote their endeavors in public" as Neil Lane, the NSF Director, has urged. Please consider participating in at least one of the many Committee activities. You can begin with an e-mail to me (hdenton@conc.tds.net). I am particularly interested in considering ways to expand outreach programs and support budding scientists.

DINNER MEETINGS

February (1997) - Dr. Don Miller

Dr. Don Miller, the President of the American Nuclear Society, addressed the Local Section in February about his vision for the second 50 years of nuclear energy. The dinner was at the Italian Market and Grill and was well attended. Don spoke about different aspects of many various subjects. Among them was a discussion on the increase in the world's population, who will require energy. Production of this energy will result in more pollution if nuclear energy is not utilized to supply power. The US currently obtains 20% of its electricity from first generation nuclear units which

operate at a 78% capacity factor. On the subject of radiation standards, he thought the linear theory on radiation exposure was costly and not based on good science. He was of the opinion that a little bit of radiation exposure is helpful and that the Health Physics Society's radiation limits for exposure (currently 5R/yr) were set too low. On the subject of competitors for production of electricity he noted that natural gas is cheapest. Gas plants are built quickly and can be operated with small staffs. Nuclear is more environmentally friendly; however, gas will not go away. The challenge is to make nuclear plants similar. We can be competitive with an assembly line plant. If China has 1/3 of US per capita, by 2050 they will require more reactors than the US (3,000,000,000 people). The American ANS must be a leader.

Much of Dr Miller's time was allocated to responding to many questions from the floor. On food irradiation, he wondered why it hasn't gone forward, as the science is OK as long as radiation exposures do not exceed certain levels. He noted that the military has used food irradiators for years. Irradiation of hamburger and chicken has the potential to save 5,000 lives in the US. In response to a question on politics,, Dr Miller thought it was important to educate Vice President Gore on nuclear issues. He planned to meet with Gore's staff in the future. In response to a question on China, Dr Miller remarked that the US cannot market nuclear technology to China. China can buy Russian, Canadian, and French nuclear technology, however. US technology is being limited. The Chinese are buying 1 CANDU for every 4 PWRs. Also, the Koreans will be competitive. With regards to the types of electrical plants being built, Dr Miller said that nuclear energy is not opposed strongly nor is it favored strongly. All new plants will be 800 Mw natural gas. They can be built in less than 5 years and operated with 50 people. On the repository, Dr. Miller thought burying high level waste is an arrogant philosophy. It should be stored above ground. The American people want it out of sight, out of mind, however. The US will require interim storage in the next couple of years. Calvert Cliffs and Oconee are candidates for life extension, but it won't happen without interim storage. In response to a question about deregulation, Dr Miller stated that single unit plants with one utility have two options: 1) Get bought up by someone else, 2) Shutdown. Several utilities are in the position to profit from deregulation. On the health of US Nuclear Engineering Departments, the news is not good. Dr Miller predicts that the number of stand alone NE Departments will be down to 0 in the next 10 years. It is difficult to maintain a stand alone department. It is better to cultivate a marriage partner and develop grass roots cooperation before a shotgun wedding results. At Penn State, Nuclear Engineering is combining with Mechanical Engineering. Michigan and Florida are under pressure. MIT may survive, although their undergraduate program is not major. Ohio State has financial problems, 15 Departments are shrinking to 8. Nuclear was part of Mechanical all along. Downsizing is primarily driven by economics.

March (1997) - Myron Kaczmarzsky

Myron Kaczmarzsky, the General Manager for Quantum-CEP™, spoke to the Local Section about the catalytic extraction process (CEP) used by Molten Metals Technologies. Their company has been in business since 1989; they have been aggressive with partnerships. They have two business units in the Oak Ridge area. Their Bear Creek Facility primarily processes resin and is a partnership with SEG and Martin Marietta (now Lockheed Martin); their M 4 Facility is near the old Scarboro School and was built in a partnership with Martin Marietta.

The CEP process consists of injecting a compound into a molten metal bath. The compounds dissolve into their elemental compounds. When mixed waste is added, the mixed waste becomes less toxic. The end products are gases, volatiles, and metal bath

products. There is no waste at the end. The exothermic reaction keeps the bath molten.

Molten Metals (MM) has also treated radioactive resin since 1994. They get volume reductions of 30:1. Their largest bath is a 3 ton unit. The costs to treat resin vary by process. Dewatering costs \$75/ft³, cementing \$100/ft³, incineration \$200/ft³, vitrification \$250/ft³, and CEP \$300/ft³. MM has 75% of the nuclear industry as customers.

MM's Bear Creek facility is designed for 130,000 ft³/yr of resinous waste, which is 100% of the nuclear industry output. Final waste is packaged in stainless steel 42 ft³ high integrity containers (HICs) for disposal. Their waste acceptance criteria allows resin which can read up to 10R/hr. MM's M4 Facility has four molten metal reactors, two of which are for mixed waste. They expect to process mixed waste from the DOE and also expect to grow in petrochemicals.

April (1997) - Dr Gary Smith

Dr Gary Smith, the Director of Nuclear Medicine and Positron Emission Tomography at the University of Tennessee hospital, addressed the Local Section in April. Nuclear imaging uses unique properties of radioactive and stable nuclides to make diagnostic analyses.

Molybdenum 99 (Mo-99) and Technetium 99m (Tc-99m) are the radio nuclides primarily involved in nuclear imaging. Mo-99 is the product from the reactor, which is chemically absorbed in a generator. Mo-99 decays to Tc-99m in the generator and the Tc-99m is flushed out of the generator with water. Tc-99m is attached to a specific chemical to image certain organs or portions of the body. It is utilized in 90+% of all nuclear medicine applications. This diagnostic tool can be used to check the heart at rest and during stress, it can also be used to see gunshot wounds, and evidence of child abuse (due to calcium buildups). The dose to the patient is less than 1 chest x ray.

Positron Emission Tomography (PET) Scanners make use of the positronic emission process whereby a positronic particle, in the presence of mass, splits into two gamma rays which travel in exact opposite directions. The patient is surrounded by a detection system which analyzes detected gamma particles and determines coincidence time windows and also backtracks the particle to a point of origin. The technique is currently experimental, so the patient is not reimbursed. PET scanners cost \$3,000,000 to start up.

The radioisotopes utilized by PET scanners are short lived and therefore must be produced at the site by a cyclotron each morning. Examples of isotopes used are F-18 (1.8 hr $t_{1/2}$), C-11 (20 min $t_{1/2}$), N-13 (10 min $t_{1/2}$), and O-15 (122 sec $t_{1/2}$). Different isotopes would be used to target different organs. For example F-18 labeled fluorodeoxyglucose (FDG or sugar) is used to detect cancer. Cancer cells metabolize faster than normal tissue and thus use more sugar. This concentrates the isotope at the cancer site. Typical scans of the brain might take up to 47 slices and take 10-15 minutes. Whole body scans might take up to 30-40 minutes. PET scanners have advantages over other imaging techniques, such as MRIs and CAT scans. After surgery, MRI and CAT scanners cannot image certain features due to scarring, PET scanners can see through the scarring.

Dr Smith also touched on Boron Neutron Capture Therapy. This is a process where a

cancer patient is treated with energy-specific neutrons which interact with a boron compound at the patient's tumor site. The neutron boron interaction results in a lithium atom and an alpha particle which ionizes the tissue within 8-10 microns of the interaction. Ionization ends the cells ability to reproduce. The boron is attached to a type of sugar which concentrates in tumor sites, so the reactions primarily ionize cancerous tissue. The goal is to concentrate 100-1000 atoms of boron per cancer cell. PET scanners can be used to image the drug peaking in the tumor. This technique is being investigated for use at the Tower Shielding Facility.

May (1997) - Dr Mark Smith

Mark Smith, Sterigenic's Corporate Manager of Technical Services, spoke to the Local Section in May on the subject of Food Irradiation. Food irradiation was first conducted in 1903. Today 37 countries irradiate food using 170 irradiators. The US Army and NASA are big users of food irradiation, as are hospitals, who irradiate food for immune compromised patients.

Food irradiation is generally conducted with high curie Co-60 sources. There is no heat added. The food can be placed in its final package prior to irradiation. The irradiation process is an additive and must be approved by the FDA for each food group separately. 500,000,000 tons of food are irradiated each year. Foods high in fat content cannot be irradiated, as the process breaks down the fat and results in unattractive odors. The irradiation process causes small, harmless molecular changes similar to changes caused by cooking, canning, and freezing. The benefits of irradiation are it reduces disease, controls insects, extends shelf life, leaves no residue, allows package processing, can be used in place of fumigants and chemicals, and causes no change in temperature.

There are currently 81,000,000 cases of food poisoning each year. Of this total, 9-10,000 persons per year die from it [Editors Note: the US Department of Agriculture estimates the annual cost of food borne illnesses to be between \$5.6 and \$22 billion]. Some causes of food poisoning are more animals in a smaller area and new modes of transport, such as cross contamination from food handling.

Some irradiated food products and allowed doses are as follows:

- Spice (biggest use of food irradiation @ 80,000,000 tons/yr worldwide), targets insects, dose limit 30 kgys.
- Flour targets insects, dose limit 0.2-0.5 kgys.
- Pork targets Trichinella, dose limit 1 kgy.
- Fresh fruits & vegetables (40% of this harvest spoils) delays ripening, dose limit 1 kgy.
- Poultry targets bacterial contamination such as salmonella, dose limit 3 kgy.

The biggest problem faced by food irradiators is public acceptance. Education is the key to opening up more products to this process.

Future Dinner Speakers

[Steve Richardson](#), the Deputy Manager DOE/ORO will be speaking to the Local Section on September 23 at the Oak Ridge Country Club. The subject of Steve's talk is "An Update on DOE's Vision for ORNL, Y 12, and K 25".

Dr Bill Appleton. will be speaking to the Local Section on October 21st about the status of the National Spallation Neutron Source. The dinner site has not been finalized.

Dr George Kabalka will be speaking to the Local Section on November 11th. The title of Dr Kabalka's talk is "Boron Neutron Capture Therapy: Knoxville/Oak Ridge at the Frontier of this New Cancer Therapy".

Nuclear facts:

In 1995, US nuclear power plants

1. prevented the discharge of more carbon than the reductions called for in President Clinton's Global Climate Action Plan.
2. reduced nitrogen oxide emissions by 2.5 million tons which is more than half of the Clean Air Act Amendments' goal.
3. cut sulphur dioxide emissions by 5.1 million tons which is more than half of the Clean Air Act Amendments' goal.

America's 109 nuclear plants generated 674 billion kilowatt hours of electricity in 1996, which is more electricity than the country consumed in the 1950s. Worldwide there are 443 nuclear generating plants contributing about 17% of the worlds electricity supply.

Threshold Radiation Effects

Recent disclosures from the National Academy of Science (NAS) are showing that low levels of radiation may not be harmful. The linear effects theory predicts that even the smallest exposure is harmful, and as exposures increase so do cancers and deaths. Findings from studies of 120,000 survivors of Hiroshima and Nagasaki show that they are not dying at increased rates, but are instead outliving their contemporaries who were not exposed. According to NAS's Evan Douple, a leading expert in the field, "radiation in general is a very ineffective carcinogen".

These results are similar to results from a 10 year study of thousands of nuclear shipyard workers conducted by Johns Hopkins. These workers' exposures to radiation have been noted to result in fewer cancers than non exposed workers are experiencing. This was a significant study because the study was attempting to find evidence supporting the linear effect theory. Similar results can be noted from studies of veterans exposed to nuclear weapons testing. These veterans show no sign of unusual illnesses or higher death rates. A University of Pittsburgh researcher tracked cancer rates in American counties with the highest levels of radon and found that cancer rates are lower in areas where radon exposure is the highest. Stay tuned.

Any person wishing to contribute to the newsletter may do so by sending their article, comment, or opinion to:
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Oak Ridge, TN 37830-6399

or

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Historical recollections are especially welcomed.

Thank You

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