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Nuclear : Ethical ?



By Henri Bonet
WCI Education and Training Committee Chair

Preamble: Many people believe that our work in the nuclear field is not ethical, relaying Greenpeace and other Environmentalist's accusations. What to respond?

Ethics distinguishes between good and evil in our choices by measuring them against universal principles, which include, among others, sustainable development and the precaution principle.

In this sense, « Atoms for Peace » was initially welcomed in the West during the fifties, as it was clearly addressing issues such as the protection of the Human Being and the Environment. It went on to become, in the sixties a political challenge for people opposing altogether militarism, capitalism and technocracy.

Ethics & Science: The human will to understand the laws of nature is based on the ethical obligation to rely on knowledge for taking rational decisions. How can it be deemed ethical to refuse to study an area of nature or to hide its knowledge when it is the basis for human progress?

The only crisis of conscience could be related to the non-ethical use of knowledge or of As for the selection of research fields and budgets appropriation, the priority should be given to satisfy quickly human well-being and urgent needs: in this sense, an ethical choice makes nuclear fusion research preferable to space exploration despite political choices.

Technical means & Science: Scientific development requires new technical means (e.g. cyclotrons). Consequently technical progress implies enhanced scientific knowledge (e.g. GEN IV reactors). The related ethical choices are thus not only linked but inseparable.

Thriving in Radiation: Many ethical issues are related to both protection against radiation and exploitation of radiation as a means for improving quality of human life.

Nuclear techniques are used in a significant number of applications outside nuclear energy production. Examples include, not only the medical sector, but also agriculture and food processing, modern industry including materials development, environmental protection, space exploration, arts & science, public security... All together, these various sectors economically dwarf that of energy production.

In spite of that, the nuclear debate is still

technical means (e.g. nuclear bomb). Science has to anticipate and control of these risks.

focused on nuclear energy production. It results that in the field of energy production, Authorities implement far higher safety and quality requirements for nuclear than for non nuclear; Moreover, all nuclear techniques outside energy production see their requirements progressively aligned with that of nuclear energy production.

Fulfilling energy needs: Availability of energy is an ethical requirement to ensuring a reliable and permanent quality of life all over the World.

The choice of energy sources is today an ethical dilemma: fossil resources are limited and lead to dangerous and polluting activities; large hydraulic installations are also dangerous and disturb the environment; solar & wind energy have irregular availability limiting their use. On the other hand, fission reactors can supply for a long period of time a large part of sustainable energy, provided safe operation is guaranteed and management of waste is enforced. One is to note that the expected availability of Fusion reactors, will eliminate most of the drawbacks of fission.

The abandonment of Nuclear energy developments has been presented in a few Countries (in Europe in particular) as an ethical political decision. However, this decision was

not justified on a technical basis but mainly as a response to the emotional public fear of « the Nuclear » exacerbated by the Tchernobyl and Fukushima accidents. In particular, right after the Fukushima events, a so-called « ethical committee » was set up in Germany and decided the immediate shut down of the older Nuclear Power Plants and a final phase out of nuclear energy by 2022.

Fortunately, this opposition has had limited impact to date on the use of the other nuclear techniques, in particular in medicine.

Acceptable Risk: The choice for nuclear energy is based on the refusal to accept the risk of shortage of energy supply in front of the acceptance of the limited risks of nuclear power operation.

The use of fission of Uranium and Thorium, with fuel reprocessing, can be increased, on the basis of current expertise, without technical limits up to quantities satisfying the world demand for centuries or at least before the industrial availability of fusion energy.

In spite of their significant contribution to the energy mix, other energy sources are not expected to eliminate the risk of shortage of supply.

The safety record of the nuclear energy is one of the best and is, at any rate, much better than that of fossil or hydraulic sources of

energy. The risk perceived by the public and exacerbated by the opponents is based on ignorance of true probabilities and damages of accidents and is emphasized by very few single accidents which are considered as less acceptable than more frequent events clearly leading to larger damages.

Safety, a key to nuclear development: From the very beginning, there was an ethical concern to maximize the safety and security of nuclear installations, which were to be operated only by authorized staff, for a limited period of time.

A key ethical approach led to the will, at local and international levels, to have Nuclear Safety Authorities, independent and with high level technical competence, performing continuous assessment of operation and imposing rules or restrictions as necessary.

Also present was the will to continuously have safety assessment, taking into account ageing and obsolescence of the installation as well as feedback from world operating experience. In this respect, «Post TMI » lessons learned led to significant upgrades.

A major issue remains the use of nuclear technologies in Countries which have not yet proved their capacity to master safety (expertise) and security (political stability).

The ethical dilemma is how and who would be

entitled to decide that these Countries represent an unacceptable risk, as some nuclear opponents do, and consequently deprive an entire population of the benefit of progress with nuclear techniques?.

Nevertheless, IAEA's actions today promote access to nuclear technologies for all people, the only restrictions being related to non-proliferation concerns.

Siting policy: The question of whether to site high production capacity on a limited number of large sites or to scatter small capacities on many sites possibly close to densely populated areas, raises many concerns related altogether to social acceptance, economy, safety & security and level of risk.

Whether small sites scattered around the country could have better social acceptance due to lower risk damage (e.g. for shortage of supply) and perception of common place activity, this nevertheless implies (i) an economic penalty due to reduced economies of scale (investments staff, safety & security,...) and (ii) increased probability of risky events. The choice of developing a network of identical facilities or implementing facilities with different designs and manufacturing provisions also affects reliability: identical facilities be less expensive but will generate have common mode concerns and issues. The choice made in many countries was generally driven by

economical more than ethical considerations with exceptions for example for small countries such as Belgium or Finland which rely on diversified designs.

Waste management: In principle, nuclear waste is only materials for which further use is not anticipated. This includes alpha emitters, radioactive isotopes 20 time more dangerous than others but with long duration of life, i.e. with low radioactivity.

Ethical principles have been enforced : waste management should :

- not lead future generations to unacceptable risks and costs,
- not affect populations having not had the benefit of the activity source of the waste
- cope with the potential of retrieval for possible further processing in the future.

Strictly speaking, spent nuclear fuel is not a waste if it is eligible to reprocessing for recovering the remaining fissile material (U,Pu) or other specific radioisotopes of use for nuclear technics (e.g. Mo99, I131, Sr90, ... Pb212 from AREVA reprocessing plants).

Furthermore, reprocessing allows segregation of isotopes according to their dangerousness and duration of life, allowing to perform specific and selective waste

management (including transmutation of specific radioisotopes for lowering dangerousness and duration of life).

The political choice made by some countries, to give up fuel reprocessing, is generally justified by the overtly stated - yet somewhat unrealistic - risk of seeing fissile material diverted for use in hand crafted atomic bombs. The only but non-ethical argument is in fact to attempt to keep control of the reprocessing technology and to eliminate the risks related to its implementation for today generations, postponing the risks for future generations.

Ethics for radioprotection: Since impacts of radiations have been anticipated, an ethical approach led international agencies (ICRP, UNSCEAR) and local Authorities to set up three principles for protection against the use of radiations :

First principle: justification is required a priori that the use of radiation provides more benefits than drawbacks and overrides other non-nuclear techniques. The enforcement of this principle might be difficult in particular in medicine when you need to have large statistics on the long term for a reliable assessment. The nuclear field is the only one subjected to this requirement and nuclear opponents would argue that any alternative techniques or energy source has then to be

preferred for having no radiation drawback.

Second principle: a radiation dose limit is laid down for workers with medical control. This limit has been reduced several times by ICRP (not followed in all countries) and the current limit recommended for the population is twenty times lower than for workers. This does not apply for emergency situations and for medical treatment of patients.

Third principle: action has to be taken for having radiation doses as low as reasonably achievable (ALARA). This ethical approach is based on the assumption that any dose is detrimental, considering a linear effect without threshold (although the effect of very low doses is still controversial). A specific ethical aspect linked to this principle in case of emergency plan, involves the choice of criteria for evacuation of population when the cost involves both effect of radiation and health effect due to displacement of people.

Ethics for medical use of radiation: Enforcement of the three radioprotection principles is not straightforward as the objective is the overall health of the patient. The choice of the techniques with the related radiation dose level, is mainly the responsibility of the medical doctor with a possible endorsement of a multidisciplinary ethical committee or health Authority. The choice of the reasonably lowest radiation doses reduces

the risk of side effects but might also reduce the efficiency of the diagnostic or therapy procedure: the right balance between these 2 conflicting benefits, is more an ethical concern than a scientific one. Nevertheless it has to be acknowledged that in many countries the medical doses are the main contributor to the population doses, far more than the one from nuclear industry.

Nuclear is non-ethical: The socially responsible investments (SRI) proposed by Banks all over the World, are selected in particular by exclusion of whole sectors of non ethical activities. Initially the sectors excluded by religious communities in the USA included activities such as weapons, alcohol, tobacco, pornography, birth control. However, environmentalist NGOs and green political Parties are currently fighting for having the

nuclear sector in the list.

Recently in France, the NGO « les amis de la terre = the friends of the world » attempted to oppose the financing as SRI, by BNP bank, of the construction in Bulgaria of both a Nuclear power plant and a large hydroelectric dam. Is it ethical that people violating a democratic decision, oppose to the financing of some technologies in some countries?

My conclusion is that beside the scientific evidence generally accepted by Man, the ethical choice between good and evil, is only a very personal option based on a belief, whether religious or philosophical.

Therefore I claim to have the right based on my freedom of thought, despite the common popular belief, to state that: **Nuclear is an ethical choice.**

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2. Message from the President-elect

Later this year I will have the privilege to take over from Dr. Van Zyl de Villiers as the 4th President of the World Council on Isotopes (WCI). My association with WCI goes right back to the beginning in 1995 when I attended, what I thought would be a “one-off”, conference in Beijing, China called the International Conference on Isotopes (ICI). Unlike similar meetings that I had attended, I was extremely pleased to see an emphasis on isotope production, a really broad range of isotopic applications and technology, a strong and diverse international participation, and an environment where both academic and industrial attendees were able to fully participate. Over the years, the subsequent ICI meetings have followed the same general structure and prescription for success allowing for some of our meetings to have in excess of 1000 attendees. Clearly the ICI meetings have filled a need in our community and therefore should continue to flourish.

In 1999 I had the privilege to chair 3ICI in Vancouver, Canada. This event was held in conjunction with the meeting of the Canadian Chapter of the International Isotope Society of which I was the President at the time. In 2005,

Nigel Stevenson, Ph.D.

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following 5ICI in Brussels, Belgium, I attended the formative meetings t

hat eventually resulted in the creation of WCI during 6ICI in Seoul.

Since then I have held the positions of

Chairperson for the Education and Training Committee and most recently as the Chairperson of the Industrial Applications Committee. The strong leadership of WCI, initially by Prof. Chang Sun Kang, followed by Prof. Myung-Chul Lee and most recently by Dr. Van Zyl de Villiers has resulted in the firm establishment of this organization to its current situation with close to 200 individual and organizational members and the monthly newsletter distributed to over 1000 readers.

I would like to express my appreciation for the trust that the WCI Executive Committee has put in me to continue this legacy and continue to grow WCI in the future. I look forward to working with the Executive and Secretariat of WCI and with all of you to collectively make WCI and ICI an ongoing and growing success.



Nigel Stevenson

3. My Biz on Isotopes <Serene, LLC>

Cynthia A Doerr, MD

Serene, LLC, is a privately held company that develops and commercializes radiolabeled diagnostic and therapeutic products using Sn-117m, for both human and veterinary medicine.

The use of Sn-117m as a medical isotope was initially developed at Brookhaven National Laboratory beginning over thirty years ago. For the last decade, the commercial application of Sn-117m has been further advanced beginning first with low specific activity manufacturing using nuclear reactors in Russia, followed by the use of the proton accelerator method which produced Sn-117m of higher specific activity. More recently, novel Sn-117m production methods using alpha particles and a cadmium-116 target have allowed Sn-117m to be inexpensively commercially produced at will in the United States, and other countries.

Although Sn-117m in various forms has been systemically used in >100 human patients with cardiovascular and oncology conditions, the most advanced product in development is a unique colloid used for veterinary, and soon human, osteoarthritis and other inflammatory joint indications. Sn-117m colloid injected into the affected joint, also known as radiosynoviorthesis, targets the macrophages

which contribute to the inflammation. The procedure has been used in humans for decades to treat osteoarthritis, rheumatoid arthritis and other conditions outside of the United States with beta particle-emitting radioisotopes. Although these treatments are generally successful, the radioisotopes used can have negative consequences when their energy is deposited beyond the tissues of the joint space. In addition, the colloids associated with these radioisotopes may leak out of the joint space and, therefore become distributed systemically causing additional irradiation outside of the tissue of interest. Serene uses a homogeneous Sn-117m colloid, called Synovetin OATM, and is finalizing enrollment in a trial of dogs with naturally occurring elbow arthritis. This product will be launched through Convetra, Inc., a dedicated veterinary subsidiary company that has been formed to commercialize this and other products related to animal health.

The second clinical application of Sn-117m colloid is for the treatment of rheumatoid arthritis and other inflammatory joint conditions in humans. Serene will begin clinical studies this year for use in humans. Numerous additional applications regarding Sn-117m

conjugates and Sn-117m colloids are planned.

Sn-117m is an isotope that emits both a photon that can be imaged with a standard gamma camera or SPECT imaging, and therapeutic conversion electrons that deposit all their energy out to ~300 micrometer in tissue. Sn-117m is unique among all other known isotopes for its utility in treating medical conditions (Figure 1). Its conversion electron energy has several distinct advantages over traditional radiation therapy including an ideal two-week half-life and an unprecedented safety profile which allows shipping with no special handling procedures. The proprietary homogeneous Sn-117m colloid is manufactured to a uniform size. The particle size is large enough to allow the Sn-117m colloid to remain >99% within the injected joint, and yet is small enough to be readily engulfed by the inflammatory synovial macrophages. The Sn-117m colloid has been fully developed and characterized with an established shelf-life of 5 weeks. Full commercial production is undergoing validation at Theragenics Corporation, (Buford, GA, USA) which has a production facility that manufactures and markets radioactive brachytherapy products globally.

Serene has several active advanced Sn-117m-based projects in human cardiovascular and oncology therapeutic indications (Figure

2). Vulnerable plaque is the primary cardiovascular target for a Sn-117m-linked biologic targeting molecule. The first indication, which has successfully completed a phase 1/2 human trial is for the treatment of symptomatic, inoperable high-grade carotid artery stenosis. For the treatment of cancer indications, several therapeutic molecules and devices are being developed. A phase 2 clinical trial for bone metastases has been successfully completed using a systemically delivered Sn-117m molecule. Several Sn-117m molecules for other oncologic indications are also in the pipeline. Additionally, Sn-117m electroplated devices for cancer treatment and palliation are in development for human and animal health.

Serene plans to embark on human clinical trials using the homogeneous Sn-117m colloid in Canada, Europe, the United States and other countries over the next five years. Additional Sn-117m conjugated products for systemic delivery will continue development for other indications including vascular atherosclerotic plaque diagnosis and treatment, as well as various oncology conditions.

Collaboration, licensing and other opportunities related to Sn-117m development are welcome. For further information please contact Cynthia Doerr, MD at cdoerr@serene-llc.com,

Figure 1

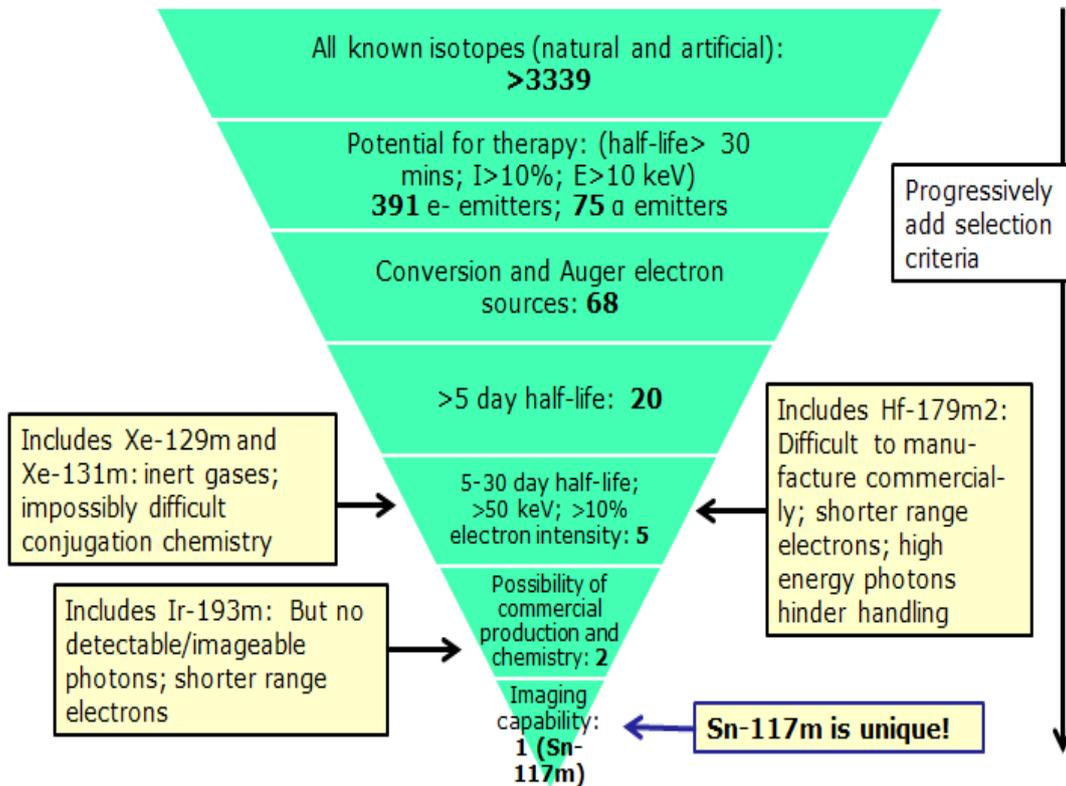


Figure 1. Search of all isotopes for candidates with ideal characteristics for Serene's medical applications.

Figure 2

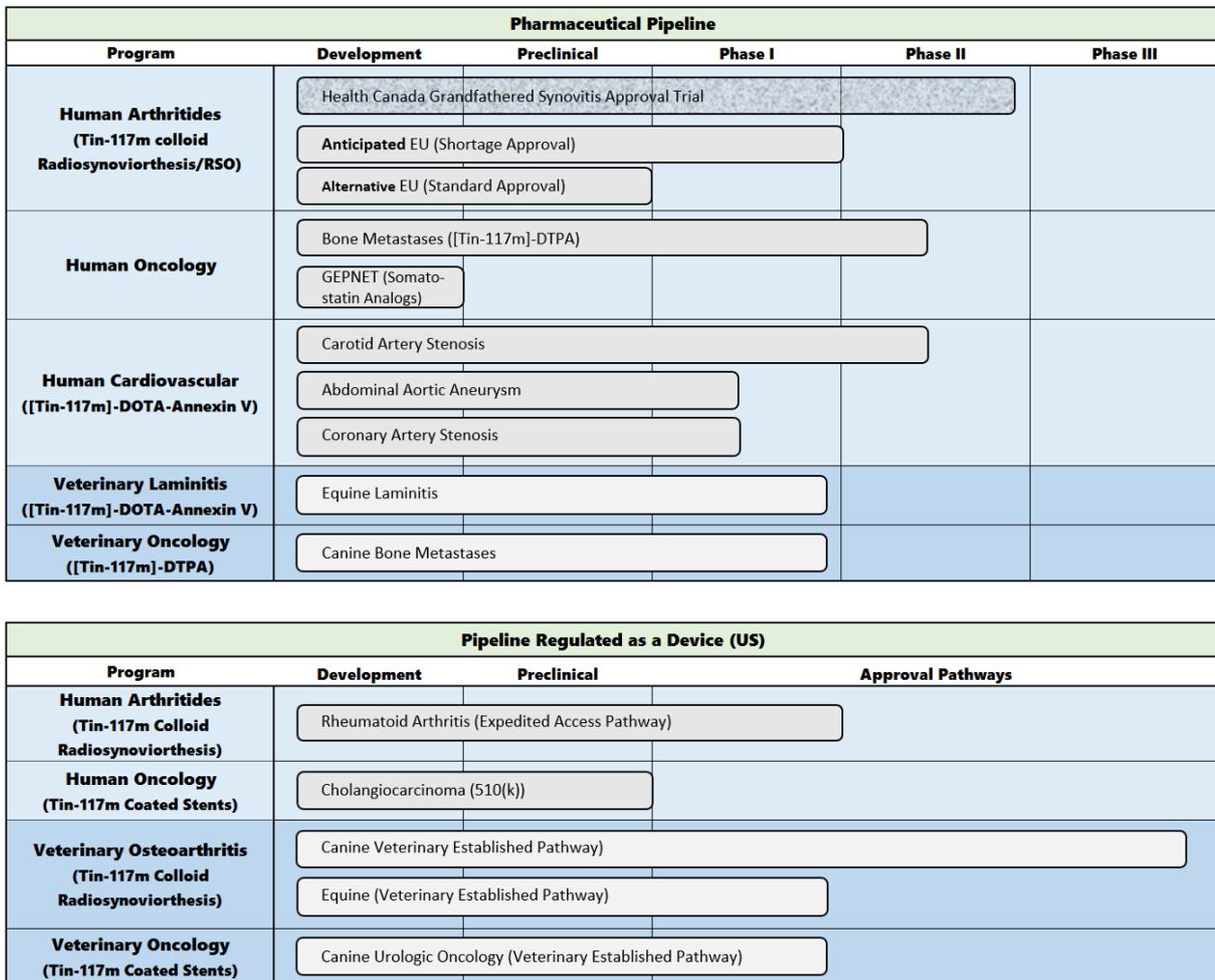


Figure 2. Serene’s device and pharmaceutical pipeline using Sn-117m.

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4. Isotope-related News

New Paper Reviews Alternative Technology to Boost Production of Mo-99

An alternative method for producing molybdenum-99 (Mo-99) could help increase the supply of this key isotope used to provide essential healthcare to millions of patients worldwide, revealed a recent paper, based on IAEA-supported research and co-authored by an IAEA expert.

As major research reactors supplying Mo-99 are aging and ceasing production, the alternative method discussed in the paper offers a simplified way to diversify production and help ensure continued Mo-99 supplies for uninterrupted nuclear medicine services.

Producing Mo-99 by irradiating natural or enriched molybdenum is one of the lesser-used yet viable alternatives to fulfil domestic needs, in particular for countries with research reactor facilities, he said.

This technique, already in use in Chile, India, Kazakhstan, Peru, Russian and Uzbekistan, involves a simpler production process and generates less radioactive waste than the traditional method of producing Mo-99 through fission from uranium. In addition, it can improve the utilization of research reactors. Several countries, including Jordan, Mexico and Morocco, are considering implementation of the technique.

While the new method shows potential, experts are still evaluating its efficiency.

To read more please visit <https://www.iaea.org/newscenter/news/new-paper-reviews-alternative-technology-to-boost-production-of-mo-99>

Source: International Atomic Energy Agency

Multiple Studies Confirm Exposure to Low Levels of Radiation Can Cause Cancer

The World Health Organization (WHO) has confirmed that exposure to low doses of radiation overtime increases the risk of cancer.

The results of the study, published in the prestigious British Medical Journal (BMJ), provide "direct evidence about cancer risks after protracted exposures to low-dose ionizing radiation," said the International Agency for Research on Cancer (IARC), the cancer agency of the World Health

Organization.

The findings demonstrate “a significant association between increasing radiation dose and risk of all solid cancers,” the study’s co-author, Dr. Ausrele Kesminiene, told sources.

“No matter whether people are exposed to protracted low doses or to high and acute doses, the observed association between dose and solid cancer risk is similar per unit of radiation dose,” he added.

To read more please visit <http://fukushimawatch.com/2015-11-05-multiple-studies-confirm-exposure-to-low-levels-of-radiation-can-cause-cancer.html>

Source: Fukushima Watch

MU nuclear reactor gets new license

Federal regulators have renewed the operating license of the University of Missouri’s nuclear research reactor.

MU said in a news release that the Nuclear Regulatory Commission granted a 20-year operating license to the University of Missouri Research Reactor Center, known as the MURR. The reactor is used to create radioisotopes for medical use and to analyze artifacts.

Construction started on the reactor in 1961, and it began operating in 1966. The university updated the reactor’s infrastructure before applying for the operating license, the university said.

To read more please visit http://www.columbiatribune.com/news/education/mu-nuclear-reactor-gets-new-license/article_68ef1e5f-f42b-5e3a-a50c-648006450c13.html

Source: Columbia Daily Tribune

Russia May Start Particle Accelerator Cancer Treatments by 2020

Pavel Lobachev, the director of the Budker Institute of Nuclear Physics, said that his institute will do the accelerator in order to begin clinical trials of the latest boron neutron capture therapy (BNCT) by 2020. NOVOSIBIRSK (Sputnik) — Russian scientists are planning to begin clinical trials of the latest boron neutron capture therapy (BNCT), which aims to destroy cancer tumors by a particle

accelerator, by 2020, Pavel Lobachev, the director of the Budker Institute of Nuclear Physics, said Monday.

The director of the Institute of Nuclear Physics also said that in the past year the scientists have been able to reinforce the particle accelerator's capacity to the level that allows to carry out the trials. According to Lobachev, the new goal was to perfect the delivery of the boron compounds into the malignant tumors.

Lobachev expressed hope that BNCT program would launch in 2017 and added that it had united a number of Russian research institutes specializing in chemistry, biology, physics and medicine.

To read more please visit <https://sputniknews.com/russia/201612261049004098-russia-cancer-particle-accelerator/>

Source: Sputnik

FDA Issues Draft Guidances on Compounding and Repackaging Radiopharmaceuticals

On December 28th, the FDA issued two draft guidances that describe FDA's proposed policies regarding the compounding and repackaging of radiopharmaceuticals for human use by state-licensed nuclear pharmacies or federal facilities, and outsourcing facilities. According to FDA, "the policies proposed in the draft guidances attempt to strike an important balance between patient access to radiopharmaceuticals compounded or repackaged by state-licensed nuclear pharmacies, federal facilities, and outsourcing facilities, and the risks that such unapproved drugs present to patients."

To read more please visit

<http://www.snmni.org/NewsPublications/NewsDetail.aspx?ItemNumber=21957>

Source: Society of Nuclear Medicine and Molecular Imaging

Taking a much closer look at corn plants

The corn plant is a big, complicated food producer. And even though farmers have been raising corn in some form for more than 9,000 years, researchers are still learning more about how this plant works. Case in point is a new report from the University of Missouri showing that researchers are turning to nuclear medicine tools to better understand the innards of the corn plant.

Missouri researchers working along with the University of Bern, Switzerland, Brookhaven National Laboratory in New York and with USDA turned to radioisotopes to trace the movement of essential nutrients and hormones through the corn plant.

The key is to find ways that natural resistance using the corn plant's built-in systems as a tool. In its work the team injected radioisotope tracers in healthy and rootworm-infested corn plants. In their work the researcher looked at auxin, which is a powerful plant hormone which is involved in stimulating new root growth. Said Richard Ferrieri, research professor, MU Interdisciplinary Plant Group: "Our target was to follow auxin's biosynthesis and movement in both healthy and stressed plants and determine how it contributes to this process."

To read more please visit: <http://www.farministrynews.com/corn/taking-much-closer-look-corn-plants>

Source: Farm Industry News

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4. Future Conferences

WM Symposia



- Date: March 5-9, 2017
- Venue: Phoenix (AZ), USA
- Website: <http://www.wmsym.org/>

The annual Waste Management (WM) Conference, presented by WM Symposia (WMS), is the world's largest and most prestigious conference on radioactive waste management & disposal, decommissioning, packaging & transportation, facility siting and site remediation. It attracts thousands of registrants from around the world and is widely regarded as the premier international conference for the management of radioactive material and related topics.

International Conference on Applications of Radiation Science and Technology (ICARST-2017)



- Date: April 24-28, 2017
- Venue: Vienna, AUSTRIA
- Website: <http://www-pub.iaea.org/iaeameetings/50814/International-Conference-on-Applications-of-Radiation-Science-and-Technology-ICARST-2017>

The first IAEA International Conference on Applications of Radiation Science and Technology (ICARST-2017) will provide a unique opportunity to achieve the following specific objectives:

- To review key developments in the applications of radiation science and technology as well as

the 'state of the science' in this field;

- To review national, regional and global initiatives for implementing proven industrial applications that lead to socio-economic benefits and strengthen capacity building in Member States
- To serve as a composite platform through which industry and academia can foster new initiatives for ensuring the success of radiation technologies in meeting the emerging challenges in various areas

ISRS 2017: 22nd International Symposium on Radiopharmaceutical Sciences



- Date: May 14-19, 2017
- Venue: Dresden, GERMANY
- Website: <http://www.isrs2017.org/>

3rd International Conference on Advances in Radioactive Isotope Science

- Date: May 28-June 2, 2017
- Venue : Keystone (CO), USA
- Website: <https://indico.fnal.gov/conferenceDisplay.py?confid=11150>

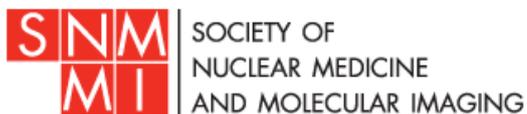
The third International Conference on Advances in Radioactive Isotope Science, ARIS 2017, will be held in Keystone, Colorado from Sunday, May 28 through Friday, June 2, 2017. ARIS is the flagship conference for rare isotope science that resulted from a merger a few years ago of the 'International Conference on Exotic Nuclei and Atomic Masses (ENAM)' and the 'International Conference on Radioactive Nuclear Beams (RNB)'.

Following the tradition of the ARIS meetings in 2011 (Leuven) and 2014 (Tokyo), ARIS 2017 will facilitate vibrant and extensive information exchange and collaboration among all the researchers in the field. The scientific program will highlight the most recent experimental and

theoretical work in the field including, but not limited to, the following topics:

- Nuclear structure and reactions
- Nuclear astrophysics
- Fundamental symmetries and interactions tested in nuclei
- Advances in nuclear theory
- Ground-state properties and fundamental constants
- Nuclei at and beyond the drip lines
- Heaviest elements and fission
- Radioactive ion beam production, experimental developments and applications

SNMMI 2017 Annual Meeting



- Date: June 10-14, 2017
- Venue: Denver (CO), USA
- Website: <http://www.snmmi.org/MeetingsEvents/Content.aspx?ItemNumber=16059>

The Society of Nuclear Medicine and Molecular Imaging organizes its annual meeting in June in Denver, Colorado, USA. This year's annual meeting will gather molecular imaging and nuclear medicine physicians, radiologists, cardiologists, pharmacists, scientists, lab professionals, and technologists, representing the world's medical and academic institutions and centers.

International Conference on Advances in Radiation Oncology (ICARO2)



- Date: June 20-23, 2017
- Venue: Vienna, AUSTRIA
- Website: <http://www-pub.iaea.org/iaeameetings/50815/International-Conference-on-Advances-in-Radiation-Oncology-ICARO2>

The conference is aimed at defining the current role and future potential of technological, medical physics and molecular/biological innovations for their incorporation into routine clinical practice in radiation oncology. It will also provide a forum where advances in technology, best practices and quality assurance methodologies can be disseminated and scientific knowledge exchanged.

IEEE Nuclear and Space Radiation Effects Conference



- Date: July 17-21, 2017
- Venue: New Orleans (LA), USA
- Website: <http://www.nsrec.com/>

The 2017 IEEE Nuclear and Space Radiation Effects Conference will be held July 17 - 21 at The New Orleans Marriott, New Orleans, Louisiana. The conference features a technical program consisting of eight to ten technical sessions of contributed papers describing the latest observations in radiation effects, a Short Course on radiation effects offered on July 17, a Radiation Effects Data Workshop, and an Industrial Exhibit. The technical program includes oral and poster sessions.

2nd International Conference on Nuclear Medicine and Radiation Therapy

- Date: July 27-28,, 2017
- Venue: Rome, ITALY
- Website: <http://nuclearmedicine.conferenceseries.com/events-list/radiopharmaceuticals>

The 2nd International Conference on Nuclear Medicine & Radiation Therapy, will be organized around the theme "Nuclear Medicine: Future breakthrough in Diagnostics & Treatment "

The conference is comprised of keynote and speakers sessions on latest cutting edge research

designed to offer comprehensive global discussions that address current issues in Nuclear Medicine 2017.

WNU School on Radiation Technology 2017



SCHOOL ON RADIATION TECHNOLOGIES 2017

- Date: October 16-27, 2017
- Venue: São Paulo, BRAZIL
- Website: <http://www.eanm.org/congresses-events/future-congress/>

The World Nuclear University RT School aims to:

- Provide a broad overview of the field of radioisotopes production and radiation technologies as well as the trends and main issues encountered by practitioners in this area.
- Develop essential skills for leadership, communication and project management.
- Provide a unique opportunity to develop a worldwide network of radiation specialists.

The RT School's intensive two-week programme features:

- Lectures by prominent experts in radioisotopes and radiation technologies and distinguished speakers.
- Small-group work led by mentors, where participants analyse case studies and develop proposals for resolving RT-related issues.
- Technical visits to RT-related sites including medical and industrial facilities.

30th Annual Congress of the European Association of Nuclear Medicine



- Date: October 21-25, 2017
- Venue: Vienna, AUSTRIA
- Website: <http://www.eanm.org/congresses-events/future-congress/>

The congress website will be launched in March 2017.

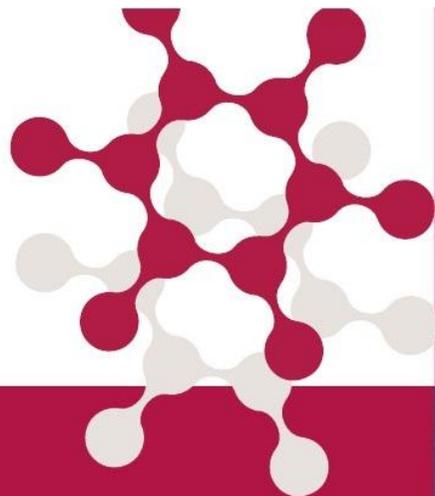
9ICI – 9th International Conference on Isotopes

- Date: November 12-16, 2017
- Venue: Doha, QATAR
- Website: <http://www.9ici.org>

The World Council on Isotopes (WCI) is proud to support the 9th International Conference on Isotopes. The ICI series has over the years been established as a prime opportunity for global isotope role-players to get together, be updated on recent developments and exchange views on different aspects of the sustainable production and beneficial use of stable and radioactive isotopes. 9ICI can be expected to provide another great opportunity for a fresh perspective on current issues, to look at the isotope field from different angles, and to be inspired to collaborate across the isotope value chain.

The WCI regards it as extremely important that researchers, producers and users of isotopes as well as policy makers and the public would share their perspectives on such a multi-faceted topic. We are convinced that 9ICI will present a great opportunity for this and, in that way, contribute to the global advancement of the application of isotope technology.

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DOHA 2017
9ICI
9th international conference
on isotopes & expo

General Chair

Ilham Al-Qaradawi, Qatar University

Assistant General Chair

Dana Al-Abdulmalik, Qatar University

Program Co-Chairs

Paul Dickman, Argonne National Laboratory

Rolf Zeisler, National Institute of Standards and Technology

**ISOTOPE
INNOVATION
THROUGH
GLOBAL
COLLABORATION**

Conference Venue:

Marriot Marquis Hotel, Doha, Qatar

Conference Registration:

Registration is required for all conference participants.
Early-bird registration fees are offered at a discounted rate.
Register at: www.9ici.org

November 12-16, 2017
Doha, Qatar

www.9ici.org

Organisers



Partner



Sponsor



Qatar brings together old world hospitality with cosmopolitan sophistication, the chance to enjoy a rich cultural tapestry, new experiences and adventures.

Doha is a world-class city in the making, with the peerless Museum of Islamic Art, perhaps the finest traditional souq in the Gulf region, and burgeoning arts and culinary scenes.

Qatar is the kind of place where you can learn about the ancient pursuit of falconry or watch camels ridden by remote-controlled robot jockeys race across the desert, admire traditional dhows bobbing on the water alongside one of the world's most spectacular modern skylines, or sample Doha's portfolio of sophisticated restaurants and then watch the sun set over sand dunes that seem to spring from an Arabian fairy tale.

Put simply, Qatar is racing headlong into the future without losing sight of its past.



Conference Topics

- >> Security of Supply, Safety and Transportation
- >> Isotope Production and Devices
- >> Isotope Research and Applications
- >> Isotopes in the Environment
- >> Quality Assurance and Quality Control
- >> Policy, Economics, and Global Impact of Isotope Production and Use
- >> Design, Construction, Operation and Decommissioning of Production Facilities
- >> Plenary Sessions including Nuclear Science and Technology in the Middle East & WCI President's Forum



About the Venue

Situated on the shores of West Bay and the sparkling blue waters of the Arabian Gulf, the landmark -5 star Sheraton Grand Doha has been restored to its former glory, preserving its authenticity while cutting-edge amenities and facilities cater to today's international traveller.



Dear Colleagues,

It is our pleasure and honour to welcome the isotope community to attend the 9th International Conference on Isotopes (9ici) to be held in Doha, Qatar 12th to 16th November 2017.

We expect to have more than 300 scientific and technical presentations and posters on show. Please check the topics, and consider presenting your work. There will also be an accompanying exhibition showcasing organisations engaging in isotope production, measurement, and various applications.

This is going to be the first time for the conference to make its way to the Middle East. Doha; the capital of Qatar, is a modern city that has a lot to offer from history, sea and sand to high tech and glorious skyline.

The conference will provide a platform for the world's leaders and best researchers in isotope technology and applications to interact and discuss the latest research in the field.

Medical physics, Women in physics and Women in nuclear, will be celebrated at a special session on the occasion of 150 years on the birth of Marie Curie.

Looking forward to welcoming you in Qatar in 2017,

Ilham Al-Qaradawi, General Chair, 9ICI

Van Zyl de Villiers, President ; WCI



IMPORTANT DATES

First Call for Papers 01 November, 2016

Second Call for Papers 06 March, 2017

Abstract Submissions deadline 15 May, 2017

Author Notifications completed 05 June, 2017

Early Registration Closed 09 October 9, 2017

Conference Dates 12-16 November, 2017

Final Papers Due 11 December, 2017

www.9ici.org