WORLD COUNCIL ON ISOTOPES
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WORLD COUNCIL ON ISOTOPES
Promotes safe and environmentally sound use of isotope technologies for global wellbeing
Newsletter
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1. Radiosynoviorthesis: A new therapeutic and diagnostic tool for canine joint inflammation

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Convetra, Inc.

Radiosynoviorthesis in clinical practice

The term radiosynoviorthesis (RSO) was introduced in Europe in the 1960s by Florian Delbarre to describe therapeutically active irradiation of the synovial lining [Ref 1]. Rheumatologists administered a colloid embedded with a radionuclide (i.e., a radiocolloid) of yttrium-90 (90Y) into the articular space. Using this process, the colloidal particles are phagocytized by macrophages in the synovial lining, after which they emit therapeutically active irradiation of the synovial tissue until the radionuclide decays to its stable state. The number of inflammatory cells causing synovitis is reduced and inflamed tissue is replaced with a fibrotic synovial membrane, with a corresponding alleviation of pain and improvement in function.

A key aspect of RSO is the choice of a radionuclide. Three radionuclides are widely used in clinical practice to treat synovitis: 90Y, rhenium-186 (186Rh), and erbium-169 (169Er), all of which are artificially produced in a nuclear reactor [Ref 2-4]. In the case of RSO treatment, the radionuclide emits radiation that penetrates the outermost layer of the synovial membrane where they produce energy of sufficient duration and intensity to achieve apoptosis and ablation of the inflamed cells. For this to occur, the radionuclide must have an adequate half-life (t½), a selective tissue penetration range approximating the synovial thickness, and sufficient energy for

therapeutic effect.

As 90Y, 186Rh and 169Er decay, they emit radiation in the form of beta particles with a relatively wide tissue penetration range (Figure 1). While these radionuclides are therapeutically useful and have been evaluated in large clinical trials [Ref 2], their physical properties are not necessarily ideal for RSO. For example, 90Y emits beta radiation that has a relatively wide range of soft tissue penetration, which risks irradiation of adjacent non-synovial tissue. 186Re and 90Y have short half-lives (2.7 and 3.7 days respectively), thereby creating storage and logistical limitations but also leading to a risk of not consistently delivering sufficient irradiation at the synovial target site [Ref 5]. 169Er lacks any diagnostic emissions which makes traceability a potential issue.

Tin-117m: A novel radionuclide

Tin-117m (117mSn) is a unique radionuclide without the disadvantages of high-energy beta-emitting radionuclides (Table 1 compares physical properties of 117mSn with other therapeutic radionuclides) [Ref 6]. As such, 117mSn is particularly well suited for RSO, including in dogs and horses. Instead of high-energy beta particles with a wide tissue penetration range (50-5,000 μm), 117mSn emits abundant conversion electrons, low-energy particles with a short, relatively non-diminishing penetration range of approximately 300 μm in tissue (Figure 1). Sn-117m has a t½ of nearly 14 days, providing an ideal duration of effect spanning several half-lives to achieve therapeutic results and to enable short-term stability during storage and handling. To illustrate, Figure 2 shows >99% dose retention in the joint of a dog three days following intra-articular injection with homogenous 117mSn colloid (Synovetin OA™) [Ref 7]. No other radionuclide exists, combining the properties of 117mSn [Ref 8].

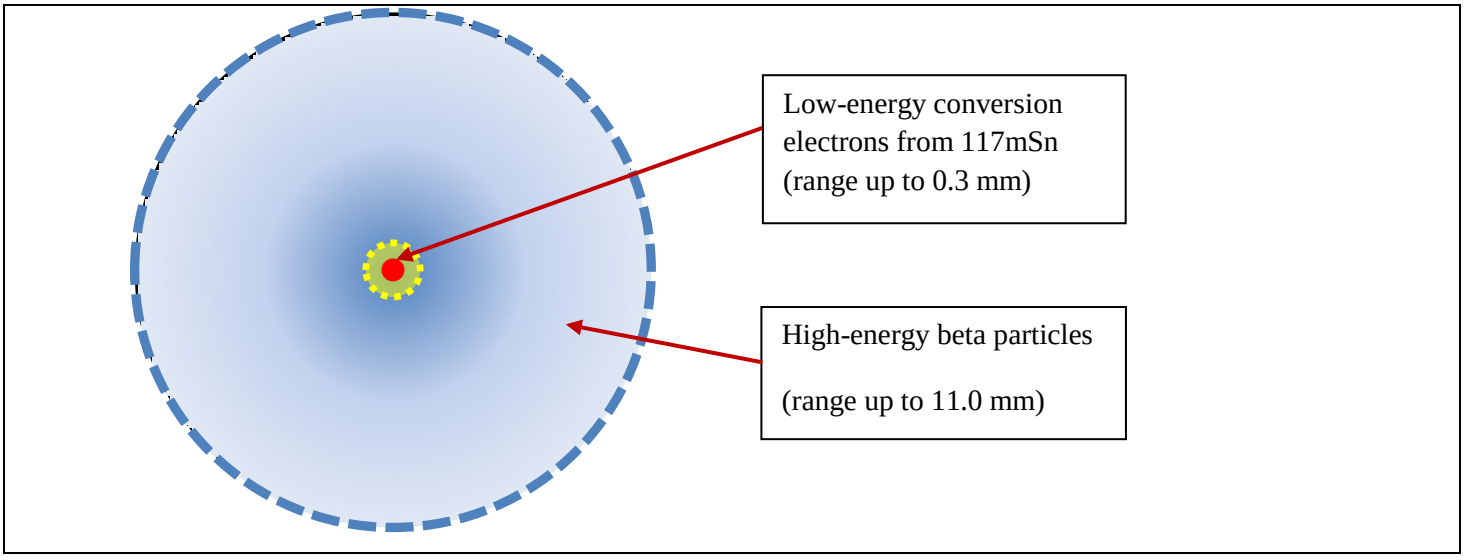

Figure 1. The diagram compares the radiation dose range of conversion electrons emitted by ^{117m}Sn (300 μm, green zone) with beta-radiation emitted by radionuclides such as ^{90}Y, ^{186}Re and ^{169}Er (up to 11,000 μm, blue zone). The ultra-narrow, discrete radiation range of ^{117m}Sn enables more precise dosimetry and avoidance of adverse effects on that beta-emitting radionuclides can have on adjacent tissues.

Due to its unique therapeutic and diagnostic (theranostic) properties as a conversion electron- and gamma-emitter with an optimal t1/2, 117mSn has attracted interest as a radiopharmaceutical and also now as a medical device in the colloid form. Favorable results were reported in clinical trials (phase I and phase II) where 117mSn was used to treat metastatic bone pain in human patients [Ref 9-11]. Investigators noted the value of the gamma emission component of 117mSn, which provides an objective basis for diagnostic monitoring, disease staging, dosage estimates, and assessing response to therapy [Ref 11-12].

Table 1 – Comparison of radionuclides commonly used for radiosynoviorthesis with tin-117m

Radionuclide	Half-life (days)	Maximum energy (keV)	Maximum tissue penetration (mm)	Therapeutic emission	Diagnostic emission (keV)
Yttrium-90	2.7	2,280	11.0	beta	None
Rhenium-186	3.7	1,070	4.4	beta	gamma (137)
Erbium-169	9.4	350	1.1	beta	None
Tin-117m	13.6	158	0.3	conversion electrons	gamma (159)

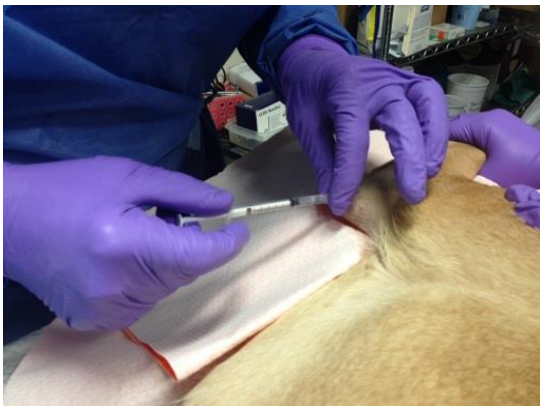

Figure 2. Scintigraphy of a Synovetin OA™ -injected canine elbow shows high dose-retention of the homogenous colloid with minimal uptake in the draining lymph node three days after administration. Retention at this time point was measured at >99% in synovial tissue, indicating a continuous therapeutic effect consistent with the 14-day half-life of ^{117m}Sn. (Image courtesy of Jimmy Lattimer, DVM.)

Figure 3. Experimental intra-articular injection of Synovetin OA™ into the caudolateral aspect of a canine elbow, positioned at 45-degree flexion, between the lateral condyle of the humerus and the triceps tendon. Following injection the joint is put through a range of motion to disperse the radiocolloid throughout the synovial surface. (Photo courtesy of Cynthia Doerr, MD.)

Synovetin OA™ - A homogenous colloid of 117mSn

Convetra Inc. has developed a patented preparation of 117mSn specifically for RSO and other potential applications in veterinary and human medicine. 117mSn is manufactured using methods that produce yields sufficient to be scaled up for manufacturing therapeutic dosages in commercial quantities [Ref 8]. The 117mSn radionuclide is combined with a homogenous colloid to form Synovetin OA™, the final injectable product [Ref 8]. The radionuclide particles are small enough to be phagocytized by synovial macrophages but large enough to avoid leakage outside the joint prior to phagocytosis. In situ retention of the Synovetin OA™ in laboratory animals has been measured out to five t½ (i.e., 68 days), a duration sufficient for therapeutic efficacy. Synovetin OA™ has demonstrated safety and efficacy following RSO of experimental OA in rats and dogs and safety in normal canine elbow joints (Figure 3).

Clinically important features of ^{117m}Sn

Several features of ^{117m}Sn make it well suited for RSO and an improvement over other therapeutic radionuclides:

- *Localized administration:* Intra-articular dosing is suitable for outpatient use.
- *Non-beta emitter:* Avoids high-energy irradiation of non-synovial tissue, extra-articular diffusion, or systemic distribution.
- *Emits low-energy conversion electrons:* Minimizes potential for synovial scarring and eliminates collateral tissue damage.
- *Gamma radiation emitter:* Gamma energy of 159 keV is suitable for diagnostic imaging and is similar to the commonly used diagnostic radionuclide Technetium-99m (140 keV).
- *Half-life of 14 days:* Enables sufficient tissue retention for therapeutic efficacy and a shelf life of several weeks.
- *Practical handling characteristics:* Ease of handling, hospital containment and shipping using standard radiological safety and packaging practices.

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2. Sketches from Secretariat

WCI Newsletter Gatekeeper Meeting held

The WCI monthly newsletter gatekeeper meeting was held on March 4 with 4 experts in the field of radiation technology.

During the meeting, the roles and missions of the gatekeepers were identified and responsibilities were defined as follows:

- To collect cutting-edge technology information on the websites and papers and submit it to the WCI secretariat
- To recommend article providers to the WCI secretariat
- To discuss the next WCI Newsletter's articles among information gathered

The number of gatekeepers will be increased up to 8 experts by each specific fields of radiation technology.

(Clockwise from left) Dr. Hyonsoo Han (KAERI), Prof. June-Key Chung (SNU), Mr. Sejun Yoon (Former Director, KONICOF), Ms. Amy Lee (WCI), Mr. Nam Ho (WCI), Mr. Woo-Geun Song (Director, WCI Secretariat)

Mr. Nam Ho (International Coordinator, WCI) met Korean Ambassador to Mongolia

Mr. Nam Ho, the international coordinator of the WCI, met with Ambassador Song Oh to discuss and identify the cooperative environment between Korea and Mongolia. This meeting occurred in the wider frame of the MoU signed last year between WCI member organizations from Korea and Mongolia, further to the mediation carried out by WCI. WCI continues to support its members to maintain close relationships and enhance collaboration with each other.

(From Left) Mr. Song Oh, Mr. Nam Ho

WCI Monthly Newsletter

Call for Articles

The WCI Secretariat provides its Monthly Newsletter to about 1,000 subscribers worldwide. WCI monthly newsletter is a communication channel for the dissemination of information among members and other interested parties in the field of isotope and radiation related technologies. For more and better information on isotopes production and application, the WCI Secretariat is cordially inviting your valuable contributions.

1. Contents

WCI Monthly Newsletter covers the followings and contributions are welcome for any of the following topics:

o Special issues: National policies, R&D outcomes, views of experts, current issues, innovative technologies in the field of radiation and radioisotopes

o Conference report: Report on relevant conferences

o Future Conferences: Any events (conferences/seminars/workshops) related to the field of radiation and radioisotopes

* Presenting events through the WCI Newsletter allows wider audiences to be informed, thereby potentially increasing participation.

o Isotope-related news: latest news related to the radiation and radioisotopes

o My biz on isotopes: topics that demonstrate the cross-cutting and interdisciplinary technologies of WCI member organizations (Please refer to the previous edition (2016 Vol. 5 Issue 2) for more details)

* This column is an excellent opportunity to raise the profile of an organization and explore business opportunities with other WCI members.

2. Requirements

The article provider should be a member of the WCI. (To join us, please visit www.wci-ici.org and sign up online. There is no membership fee.) The writer should be a professional working in the field of ***isotope production or the application of isotopes or radiation.***

3. Format

- All articles should be written in English.

- The length of article should be within 4 pages (A4, Verdana with 10 font size and 1.5 line spacing).
- Images may be included.

All submissions meeting the above requirements should be submitted to secretary@wci-ici.org.

4. Deadline

Articles received by the WCI Secretariat via email before the **10th of the month** will be considered for the upcoming newsletter.

5. Others

The WCI Publication Committee Chair will review articles for possible inclusion in the newsletter. Articles might be edited according to our own format. The WCI Secretariat will make payment only for **special issues articles**.

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3. Future Conferences

International Conference on Effective Nuclear Regulatory Systems: Sustaining Improvements Globally

- Date: April 11-15, 2016
- Venue: Vienna, AUSTRIA
- Website: http://www-pub.iaea.org/iaeameetings/50799/International-Conference-on-Effective-Nuclear-Regulatory-Systems-Sustaining-Improvements-Globally

This conference is being organized by the International Atomic Energy Agency (IAEA) and will be the fourth in a series of conferences on Effective Nuclear Regulatory Systems. Building on the conclusions and deliberations the three preceding conferences (Ottawa 2013, Cape Town 2009 and Moscow 2006), the present event, to be held in April 2016, will play a vital part in the global efforts by senior nuclear safety and nuclear security regulators to review issues that are important to the global nuclear regulatory community, and will focus, in particular, on their key role in ensuring safety and security.

Annual Meeting of Australian and New Zealand Society of Nuclear Medicine (ANZSNM 2016)

- Date: April 22-25, 2016
- Venue: Rotorua, NEW ZEALAND
- Website: http://www.anzsnm2016.com

The scientific program has been designed to present the latest findings in Australasian research and to engage participants in practical workshops that have broad appeal. The invited speakers will focus on the theme: —Hot Science: An Eruption of Isotopes‖ and a subtheme on quantitative nuclear medicine, delivering evolving ideas on the science and clinical application of new isotopes and radiopharmaceuticals.

14th International Congress of the International Radiation Protection Association

- Date: May 9-13, 2016
- Venue: Cape Town, SOUTH AFRICA
- Website: http://www.irpa2016capetown.org.za/

The 14th Congress of the International Radiation Protection Association will be held at the Cape Town International Convention Centre, South Africa between 9 – 13 May 2016.
The theme of the Congress is "Practising Radiation Protection: Sharing the Experience and New Challenges".
The Congress will feature a comprehensive scientific and technical program covering all aspects of radiation protection, all-round technical exhibition and technical visits program, and a versatile selection of Refresher Courses

4th International Conference on Radiation and Applications in Various Fields of Research (RAD 2016)

- Date: May 23-27, 2016
- Venue: Niš, SERBIA
- Website: http://www.rad-conference.org/news.php

The aim of the Conference is to provide a forum for researchers and professionals from various fields of biology, chemistry, physics, medicine, environmental protection, electronics, etc, involved with ionizing and non-ionizing radiation, as well as other areas connected to them, to exchange and discuss their findings and experiences. The Conference program includes topical invited lectures, a limited number of oral presentations, and poster presentations. The official language of the Conference is English.

SNMMI 2016 Annual Meeting

SOCIETY OF NUCLEAR MEDICINE AND MOLECULAR IMAGING
ANNUAL MEETING
June 11-15, 2016 • San Diego, California

- Date: June 11-15, 2016
- Venue: San Diego (CA), USA
- Website: http://www.snmmi.org/AM2016?navItemNumber=581

The SNMMI 2016 Annual Meeting—the premier educational, scientific, research, and networking event in nuclear medicine and molecular imaging—provides physicians, technologists, pharmacists, laboratory professionals, and scientists with an in-depth view of the latest technologies and research in the field.
Japan will be the highlight country of SNMI 2016; the Annual Meeting will highlight the latest advances in research, technology, and clinical practice in Japan. Programming will include JSNM/ SNMMI joint sessions on:

- Nuclear Medicine and Radiology Education: Multidisciplinary Teams
- Tau Imaging in Neurology
- [F-18]FDG PET-CT in Lung Cancer

SNMMI's Annual Meeting offers full-day categorical seminars to provide you with a deeper level of understanding as you examine a single topic of clinical, scientific, or academic interest.
Topics include:

- Radionuclide Imaging of Inflammation and Infection: State of the Art and New Developments
- Molecular and Multimodality Imaging in Cardiovascular Disease
- Molecular Imaging of Cancer Metabolism: Basic Science, FDG, and Beyond
- Basic to Advanced PET/CT: A Practical Update
- Imaging and Therapy of Neuroendocrine Tumors
- Brain PET/MRI – Clinical Challenges, Potential, and Workflows
- Small Molecule PET Radiotracers
- 'Theranostics' Beyond Neuroendocrine Tumors: Novel Applications of Targeted Radionuclide Therapy in Malignant and Nonmalignant Conditions

Annual Meeting of the American Nuclear Society (ANS 2016)

- Date: June 12-16, 2016
- Venue: New Orleans (LA), USA
- Website: http://ansannual.org/

The theme of this year's Annual Meeting is "Nuclear Power: Leading the Supply of Clean, Carbon Free Energy". More than 800 attendees are expected to attend, representing every field of nuclear science and technology from across the United States and many countries throughout the world.

IEEE Nuclear and Space Radiation Effects Conference (IEEE NPSS)

- Date: July 11-15, 2016
- Venue: Portland (OR), USA
- Website: http://www.nsrec.com/

The 2016 IEEE Nuclear and Space Radiation Effects Conference will be held July 11 - 15 at The Double Tree and Oregon Convention Center, Portland, Oregon. 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 11, a Radiation Effects Data Workshop, and an Industrial Exhibit. The technical program includes oral and poster sessions.

Papers on nuclear and space radiation effects on electronic and photonic materials, devices, circuits, sensors, and systems, as well as semiconductor processing technology and design techniques for producing radiation-tolerant (hardened) devices and integrated circuits, will be presented at this meeting of engineers, scientists, and managers.

16th International Workshop on Targetry and Target Chemistry (WTTC16)

- Date: August 29-September 1, 2016
- Venue: Santa Fe (NM), USA
- Website: http://www.wttc16.us/

The 16th International Workshop on Targetry and Target Chemistry (WTTC16) will be held in Santa Fe, New Mexico, August 29st – September 1st of 2016. The Department of Energy's National Isotope Program and Los Alamos National Laboratory (LANL) Chemistry Division will act as technical hosts for the gathering of international experts to participate in a uniquely collaborative workshop format.
The WTTC16 will emphasize student contributions and a collaborative, discussion-oriented format, in keeping with the history of the Workshop series.

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

- 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;
  - national, regional and global initiatives for implementing proven industrial applications that lead to socio-economic benefits and strengthen capacity building in Member States; and
- 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

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4. Isotope-related News

Feds Approve SHINE's Plan for Janesville Radioisotope Plant

(Janesville, WI) Neil Johnson, Gazette

After four years of development, regulatory screening and a complex approval process for a proposed radioactive medical isotope production facility in Janesville, SHINE Medical Technologies has received the clearance it's been waiting for.

Thursday morning, the federal Nuclear Regulatory Commission voted to approve SHINE's request for a construction permit to build a 57,000-square-foot radioisotope facility at 4021 S. Highway 51 across from the Southern Wisconsin Regional Airport on Janesville's south side.

The federal panel has spent the last two years vetting the proposed project for safety and environmental impacts.

The review essentially gives SHINE the go-ahead to construct the facility, which will use nuclear particle accelerators to produce the radioactive medical isotope molybdenum 99 from low-enriched uranium.

The Nuclear Regulatory Commission still must complete a separate, lesser phase of regulatory review for SHINE's operating permit, but under the panel's decision Thursday, SHINE has the clear to move into construction and commercialization phases of the project.

SHINE is on track to break ground on the project in 2017, and the company will begin ramping up operations in 2018. That puts SHINE on pace to begin shipping moly-99 in early 2019, SHINE Vice President Katrina Pitas said Thursday.

"We're shooting for that goal and working as hard as we can to get there," Pitas said.

The facility in Janesville is slated as one of three or four radioisotope production facilities that could operate in the U.S. within a couple of years, Pitas said.

Molybdenum-99 is a radioisotope used to illuminate heart, bone and other body tissue in 40 million medical imaging procedures a year. It is mainly used in heart disease screening, stress tests and for bone scans used to locate and diagnose cancer.

SHINE would operate the first U.S. moly-99 production facility in the nation since the 1960s.

Another medical radioisotope company, NorthStar Medical Radioisotopes, is operating in Beloit, but NorthStar does not yet produce moly-99 on site.

SHINE would produce moly-99 on site, then ship the isotope to suppliers, which would distribute to Midwest specialty pharmacies. The company also would supply markets abroad, Pitas has said.

SHINE has major supply agreements with GE Healthcare and Lantheus Medical Imaging.

It would be the first entirely private outlet through which Moly-99 would be produced, distributed and shipped to hospitals and medical testing laboratories, SHINE officials say.

Pitas on Thursday said a mix of SHINE employees and a handful of initial investors—about 40 people--watched a remote, live stream of the nuclear panel's meeting Thursday on TVs throughout the company's Monona headquarters.

She said as the news came, SHINE's headquarters broke into cheers. Engineers, company executives and investors embraced.

As Pitas took photographs of the moment, she said her eyes brimmed with tears. And she wasn't the only SHINE employee who cried in joy.

"It was exhilarating. It's what we've been waiting for. We've dedicated years of our lives to this," Pitas said.

The company has developed a special set of particle accelerators that it has spent nearly half a decade testing in partnership with federal nuclear programs.

Pitas has said that in recent months, the Nuclear Regulatory Commission had "raced" through latter stages of a review process, following a weeks of page-by-page review of tens of thousands of pages of SHINE's plan documents and related report. Review included months of public comment, research by the panel's staff and an independent review by a team of federal cross-checkers.

Because the facility will rely on nuclear particle acceleration, the federal panel had required SHINE to conduct intensive calculations and hypothetical modeling to prove that its plans met federal thresholds for safety and environmental impact.

Among the research, SHINE was required to calculate the potential risk and impact to SHINE's Janesville facility if tsunami-like waves ever formed on Lake Michigan or Lake Superior—and then rushed over the Wisconsin landmass, covering Janesville with water.

Belying the intensity of regulatory review, federal authorities and the U.S. Department of Energy have been supportive of the idea of SHINE's project and a few other medical radioisotope production facility plans, mainly because of the specter of a world shortage of moly-99.

The U.S. is responsible for about half the world's demand for moly-99, yet none of the radioisotope is produced here. All of the material is imported from government-owned nuclear reactors in Canada, Europe and Africa.

Most of those foreign reactors are aging and are slated to be shut down within a few years. That would lead to a shortage of moly-99 not just in the U.S., but worldwide.

SHINE continues to raise money to construct and commercialize the Janesville facility.

As of this week, Pitas said, the company has raised approximately $50 million, including $22 million in private funding, through two waves of fundraising and a $15 million U.S. Department of Energy cost-share agreement.

Earlier estimates of the project's cost totaled $85 million, but Pitas has more recently declined to discuss specifics about the project's full costs.

SHINE's timeline for breaking ground and ramping up production at its Janesville facility has shifted a few times from an initial estimate that it would be producing and shipping moly-99 commercially in Janesville by 2017.

The delay came as SHINE's project plans remained under regulatory review.

Pitas said that between financing that SHINE has in hand, its supplier partnerships, and the federal government nod to the project on Thursday, SHINE is "well-positioned to finance the upcoming commercialization phase," Pitas said.

On Thursday, Pitas said there's "nothing tentative" about SHINE's plan to have a facility built and producing on a commercial level by early 2019.

SHINE plans a private "celebration event" Thursday, March 10, in Janesville.

The city of Janesville has a stake in the SHINE plan. Years prior to the project getting full regulatory approval, the city council approved a tax increment financing incentive package worth $9 million, including utilities, land and cash and an agreement to back a private loan to SHINE.

The only city TIF agreement larger than SHINE's was an incentive package of $11.5 million, which the city awarded last year to Dollar General, which plans to build a 1 million-square-foot distribution center on Janesville's south side.

The city's incentive package for SHINE is tied to the company meeting criteria of property tax payments and job creation in Janesville.
SHINE has said it eventually would employ 150 at the Janesville facility, including technicians and mechanics. Many of the positions would pay annual salaries at or near $60,000, Pitas has indicated.

Pitas indicated SHINE plans to working on partnerships with at least one area technical college to launch training programs for radioactive material handling.

Pitas said that during the facility's expected life, SHINE will produce enough moly-99 for tests for 1 billion patients.

"Today is a day when everybody in the community and the whole state of Wisconsin should be

proud of what we've achieved … coming to market and producing the isotopes they need to stay healthy," Pitas said.

* SOURCE: GazetteXtra

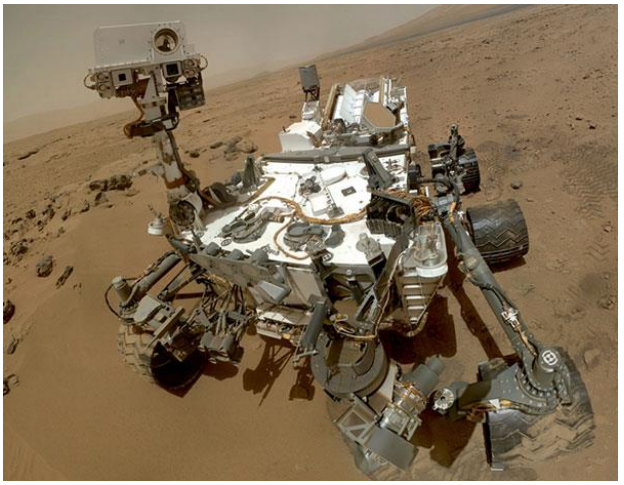
http://www.gazettextra.com/20160225/feds_approve_shines_plan_for_janesville_radioisotope_plant

Oak Ridge scientists produce first plutonium-238 in 28 years

A joint NASA–DOE effort has made a test batch of an isotope used to power deep space missions.
Mitch Ambrose

On 22 December, the Department of Energy announced in a press release that for the first time since 1988 the US produced plutonium-238. The demonstration batch of 50 grams created by scientists at Oak Ridge National Laboratory represents an important step toward producing the plutonium necessary to power NASA's future deep space exploration missions. This production of 238Pu also involves Idaho National Laboratory, which provides the necessary neptunium-237, as well as Los Alamos National Laboratory, which will store the plutonium oxide produced by Oak Ridge.

Plutonium-238 is used in radioisotope power systems (RPSs), devices that convert heat from radioactive decay into electricity to power space probes and rovers that cannot acquire enough energy from solar panels alone. NASA's current RPS is the Multi-Mission Radioisotope Thermoelectric Generator (MMRTG), which uses approximately 4 kilograms of 238Pu to produce about 110 watts of power. The Curiosity rover on Mars uses an MMRTG, and another MMRTG is set aside for the Mars 2020 rover.

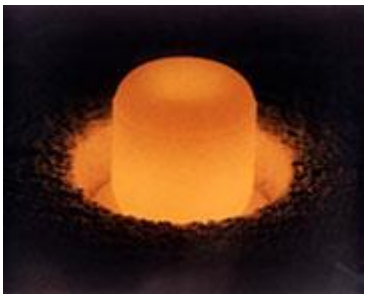


The Mars Curiosity Rover relies on plutonium-238 for power. (Photo credit - NASA)

RPSs have been integral to NASA's deep space exploration efforts for more than 50 years—powering iconic exploration efforts ranging from the Voyager missions to the recent New Horizons mission to Pluto—and they are expected to be an essential component of NASA's planetary science missions for the coming decades. Indeed, one of the ten broad conclusions of the recent Nuclear Power Assessment Study conducted by researchers at the John Hopkins University Applied Physics Laboratory is that "[the need] for nuclear power systems is expected to extend for at least one more decade past that covered by the current decadal surveys." That unavoidable need for 238Pu to support critical science missions led the Obama administration and NASA to broker an agreement with DOE to resume production of 238Pu using NASA funds starting in 2012. To date, NASA has spent more than $200 million to support this restart.

The US currently has 35 kg of 238Pu reserved for civil space purposes, with an unspecified additional amount reserved for national security purposes. Only about 17 kg of the 35 kg is of sufficient quality for use in an RPS. However, the remaining material could perhaps still be used if blended with newly produced 238Pu. The press release indicates that DOE hopes to scale up production initially to 0.4 kg per year and eventually to an average of 1.5 kg per year. According to a statement by a DOE official during a presentation to NASA's Outer Planets Assessment Group, DOE expects to reach an output of 0.4 kg per year by 2019 and of 1.5 kg per year by the mid 2020s, based on current budget projections.

The committee report for the fiscal year 2016 House Commerce, Justice, and Science Appropriations Act provides guidance for $20 million from the amount made available for the Planetary Science Technology program to be used for NASA to work with DOE to "domestically produce between 3.3 and 11 pounds [1.50 and 5.00 kg] of plutonium-238 annually beginning in fiscal year 2016." The corresponding Senate committee report is silent on the subject. The joint explanatory statement that accompanied the final fiscal year 2016 appropriations law lowers the funding amount to $15 million but retains the rest of the language.



Plutonium oxide pellet. (Photo credit - DOE)

A Stirling alternative to MMRTGs?

A potential alternative to the MMRTG is the Advanced Stirling Radioisotope Generator (ASRG), a yet-to-be-fully-developed RPS that could produce more power using about a fourth as much 238Pu. Proponents of the technology point to its ability to reduce demand on the 238Pu stockpile and decrease urgency of restarting production as rationale for ASRG development. In addition, a 2009 National Academies study on RPSs recommended that NASA complete development of an ASRG "with all deliberate speed." Similarly, the 2013–22 planetary science decadal survey study committee argued that the "highest priority for near-term multi-mission technology investment is for the completion and validation of the ASRG."

However, after investing about $270 million into ASRG development from 2008 to 2013, NASA canceled the ASRG program in 2013, citing budget constraints and a desire to spare programs such as the small- to medium-sized Discovery- and New Frontiers–class missions. Nevertheless, NASA has not completely given up on Stirling technology, recently issuing a request for information on use of Stirling devices for space power generation.

Ohio delegation pushes for details on potential use of Stirling generators

Unsurprisingly, multiple members of the Ohio delegation desire to know more about the potential use of advanced Stirling generators for space exploration. Ohio is home to NASA's Glenn Research Center—the center responsible for RPS development—as well as Sunpower, a contractor involved in the ASRG program. In July 2015, Senator Rob Portman (R-OH) and Sen. Sherrod Brown (D-OH) introduced the Efficient Space Exploration Act in the Senate, and Representative Steve Stivers (R-OH), Rep. Bill Johnson (R-OH), and Rep. Marcia Fudge (D-OH) introduced the companion bill in the House.

Both of those bills require the White House Office of Science and Technology Policy (OSTP) and NASA to submit a report to Congress that assesses NASA's projected mission requirements for RPS material, plans for use of "advanced thermal conversion technology, such as advanced thermocouples and Stirling generators and converters," schedule risks associated with potential delays in domestic production of 238Pu, and the costs of producing such material. The bill also

directs the OSTP and NASA to explain how NASA has "implemented or rejected" recommendations from the 2009 National Academies RPS study.

That language is included in both NASA authorization bills considered by the House last year (H.R. 810 and H.R. 2039) except for a provision in the Ohio bills that specifies that the report "identify the steps the Administrator will take to preserve taxpayer investment to date in Advanced Stirling Convertor technology." The Senate has yet to begin consideration of a NASA authorization bill.

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