


CLEAN NUCLEAR POWER. SAFE HOSPITALS.

Working together to
keep hospitals around
the world clean and
safe, while supporting
health care innovation.





Bruce Power
and Nordion –
Working together
to keep hospitals
around the world
clean and safe,
while supporting
innovation in
health care.

www.cleannuclearpowersafehospitals.com



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EXECUTIVE SUMMARY

When people think about nuclear power, they think about electricity that reliably keeps the lights on in their home and powers their day-to-day electronics and kitchen appliances.

For the health care sector, nuclear power's impact is two-fold – it can be counted on to keep the lights on in operating rooms and powering lifesaving equipment, while also being a reliable source of Cobalt-60, a medical isotope used for sterilization of medical equipment in hospitals around the world. Other types of medical grade isotopes are also an important element in cancer treatment.

www.cleannuclearpowersafehospitals.com



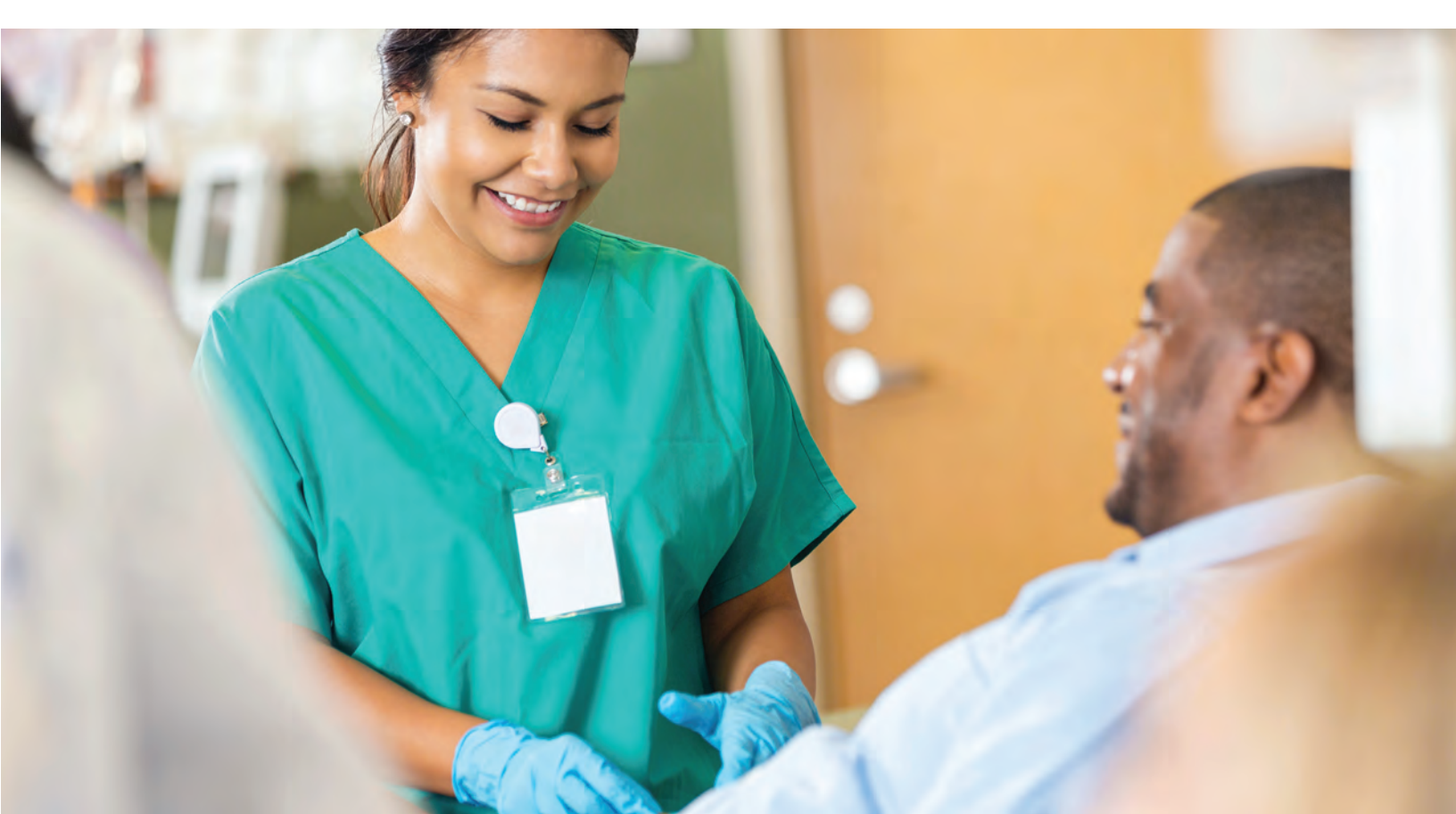
Clean nuclear power and safe hospitals are more intricately intertwined than you think. By working together, Bruce Power and Nordion will continue to build on their strong partnership, which will benefit health care providers and patients for many years. Bruce Power already supplies Cobalt-60 to Nordion for sterilization through this partnership. Bruce Power will provide Nordion with a reliable, long-term supply of medical-grade Cobalt-60 at a time when the world is facing a global shortage.

Ontario has recognized the nuclear industry as part of a balanced, clean supply mix that is acknowledged internationally for its safe production of carbon-free

electricity. Ontario is also home to many globally respected health care institutions, suppliers of important technologies and support services.

The partnership between Bruce Power and Nordion will continue to keep the province at the forefront of innovations that save lives, improve quality of life and invest to our economy.

The long-term supply of Cobalt-60 from Bruce Power is an example of Ontario's innovation at work, which is helping meet the needs of a modern health care system while also securing high-tech jobs in Ontario.



OUR PARTNERSHIP

About Nordion

Nordion, a Sotera Health company, is a leading provider of medical isotopes and gamma technologies used for the prevention, diagnosis and treatment of disease and infection. Nordion's products are used daily by pharmaceutical and biotechnology companies, medical-device manufacturers, hospitals, clinics and research

laboratories. Nordion supplies products to more than 40 countries around the world, and is committed to safeguarding global healthcare.



www.nordion.com



About Bruce Power

Bruce Power is Canada's only private sector nuclear generator, and the world's largest operating nuclear facility. Bruce Power is a Canadian-owned partnership of TransCanada Corp., Borealis Infrastructure (a trust established by the Ontario Municipal Employees Retire System), the Power Workers' Union and The Society of Energy



Professionals. Bruce Power is a leading clean energy company committed to providing about a third of Ontario's electricity annually, while producing zero carbon emissions and keeping prices stable and affordable for Ontario's families, schools, hospitals and businesses.

www.brucepower.com



Cobalt-60 sterilizes single-use medical devices, including masks, gloves, implantable devices, as well as some food products like spices.



Working Together

For more than 30 years, the reactors at Bruce Power's Bruce B generating station have been a reliable Cobalt-60 supply for Nordion. Cobalt-60 is used to sterilize more than 40 per cent of the world's single-use medical equipment.

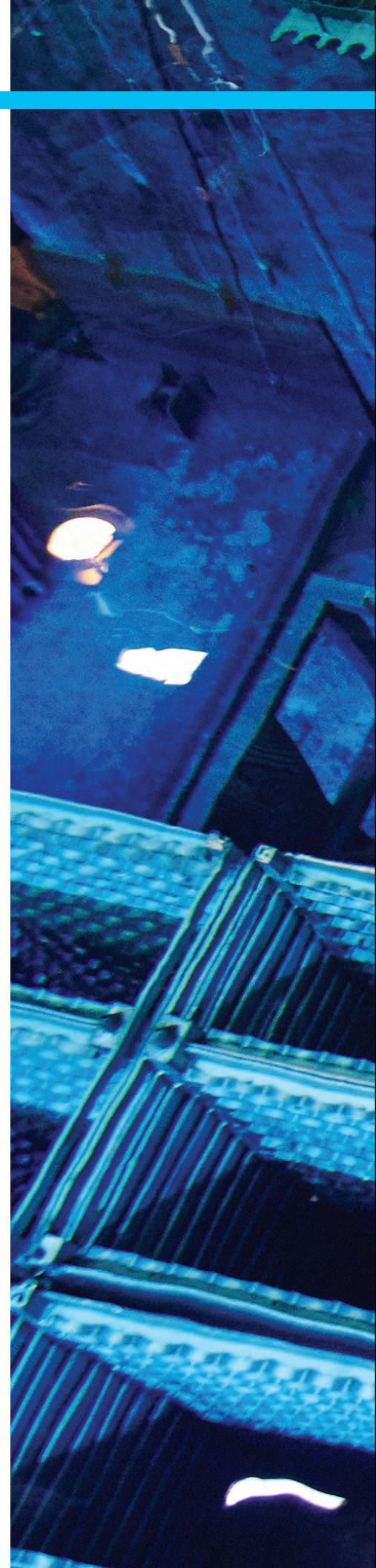
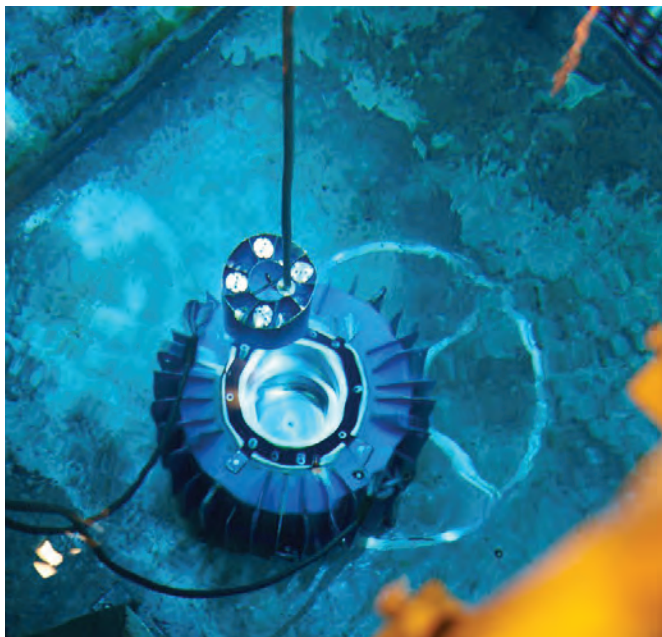
In 2016, Bruce Power and Nordion will build on their strong partnership and respective strengths by expanding their relationship, entering into an agreement to supply an important medical-grade Cobalt-60 supply, which will benefit cancer patients in Canada and around the world.

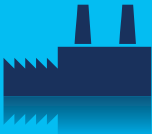


COBALT-60 PRODUCTION

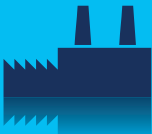
Cobalt-60 is an isotope that emits gamma rays essential to the medical community for cancer treatments, as well as sterilization of medical devices.

Working together, Bruce Power and Nordion provide a reliable, long-term Cobalt-60 supply.



**MINE****MANUFACTURER**

Plant manufactures
Cobalt-59 pellets and slugs.

**MANUFACTURER**

Plant assembles the source
elements and adjusters,
and then delivers them to
the reactors.

**NUCLEAR REACTORS**

The Cobalt-59 adjuster rods
are installed in the reactor and
the Cobalt-59 is activated to
become Cobalt-60.

**SHIPPING VEHICLE**

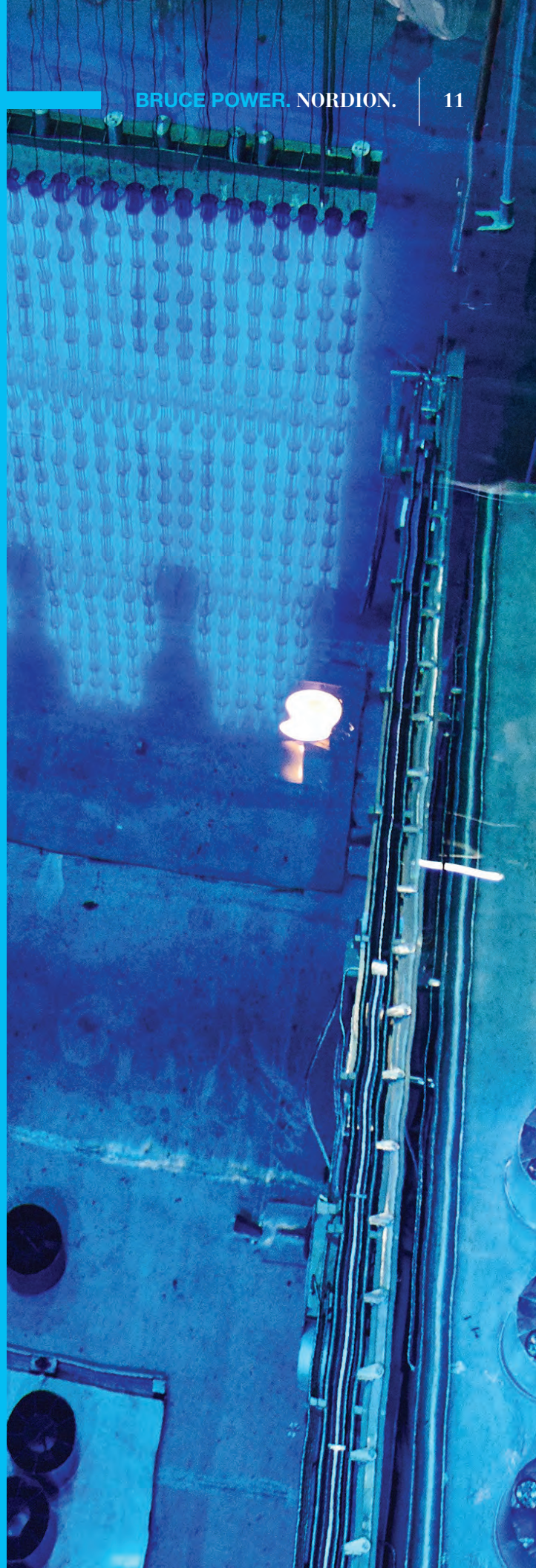
The Cobalt-60 is removed
from the reactor and shipped
to the processing facility.

**ISOTOPE PROCESSORS**

At the facility, the Cobalt-60
is processed into sources for
industrial or medical use.

**SHIPPING VEHICLE**

The sources are shipped to
the customer.





Bruce Power harvests the rods during planned maintenance outages on the four reactors at Bruce B.

The Cobalt-60 rods are then stored in Bruce Power's secondary fuel bay. The harvested rods are suspended on the wall of the fuel bay, about 14 feet below the surface; the water providing employees with the necessary shielding from the radioactivity. From the reactivity mechanism deck over the fuel bay, Bruce Power's specialized fuel handlers extract the individual irradiated rods and place them in a shielded flask to be shipped to Nordion's facility.



HIGH SPECIFIC ACTIVITY COBALT-60

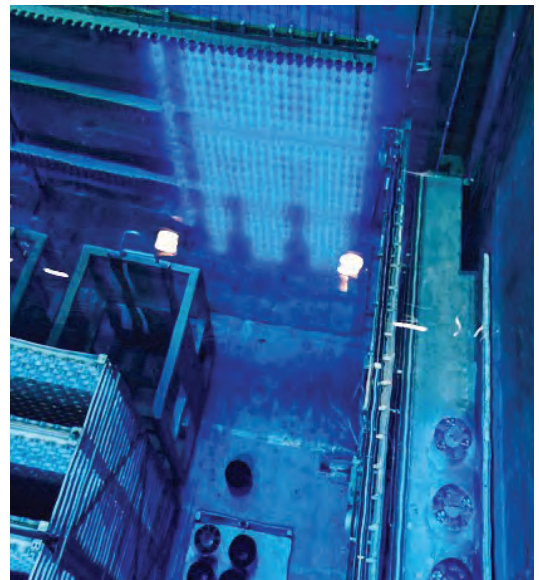
For over six decades, Nordion's supply of medical-grade Cobalt has come primarily from the National Research Universal (NRU) reactor at Chalk River, ON.

Recognizing that in a few years the NRU reactor will reach its end-of-life, it was critical to find another source of High Specific Activity (HSA) Cobalt-60 for these life-saving procedures.

This new source of supply from
Bruce Power will assist to fill this gap.

HSA Cobalt-60 is produced in a limited number of nuclear reactors globally and is used in radiation-based cancer treatments, as well as other diseases in Canada and around the world.

Bruce Power is one of the world's largest suppliers of Cobalt-60. With plans to extend the life of Bruce Power's facility to 2064 through refurbishment of six of its reactors, there will be a stable worldwide source of Cobalt-60 for many years.



The World Nuclear Association estimates the demand for radioisotopes is increasing up to five per cent annually.

GLOBAL COBALT-60 PRODUCTION

**National
Research
Universal**

Chalk River, ON
(end-of-life March 2018)



Bruce Power

Bruce B (four reactors)



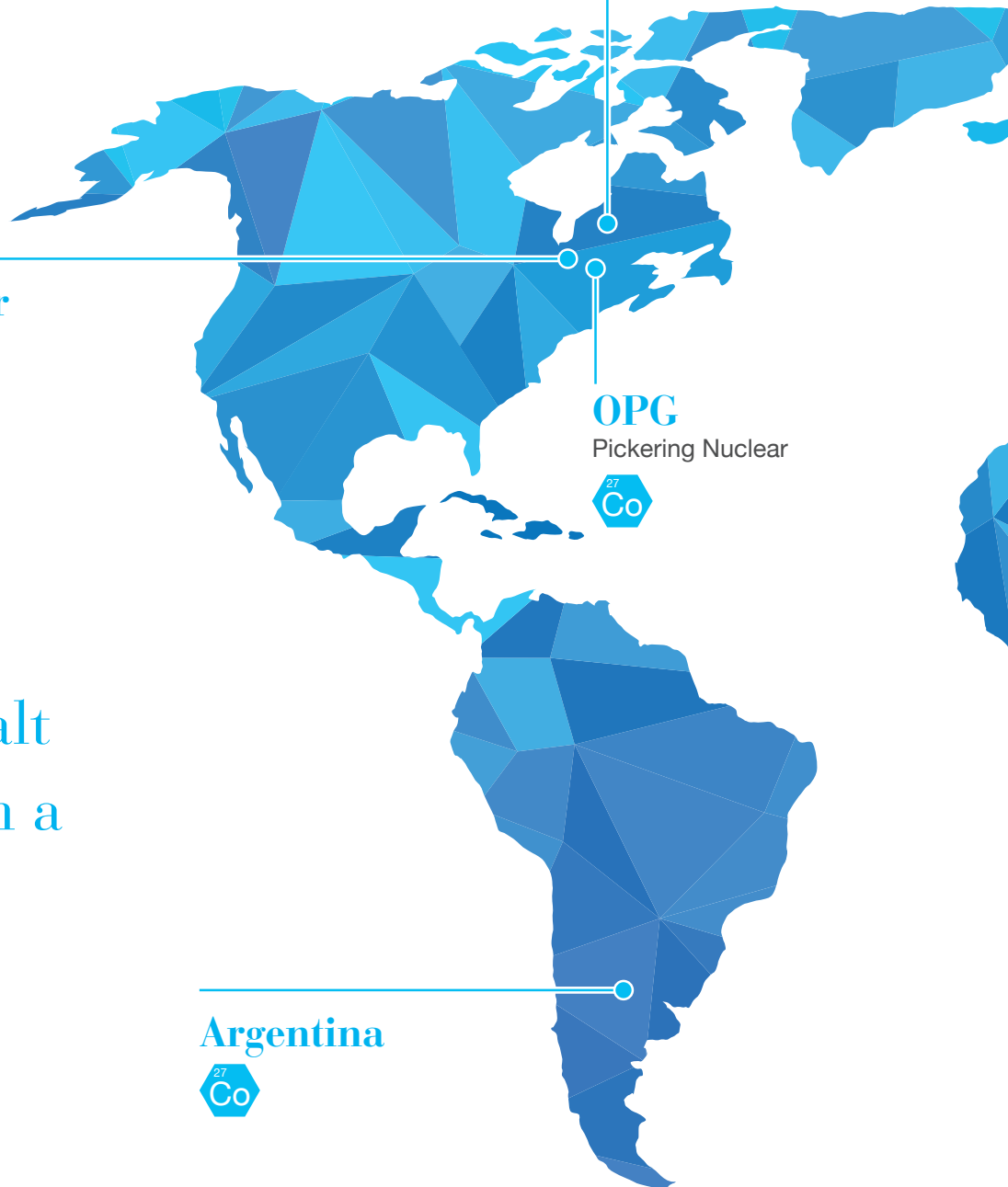
OPG

Pickering Nuclear



This map
displays Cobalt
production on a
global scale.

Argentina





COBALT-60 USES

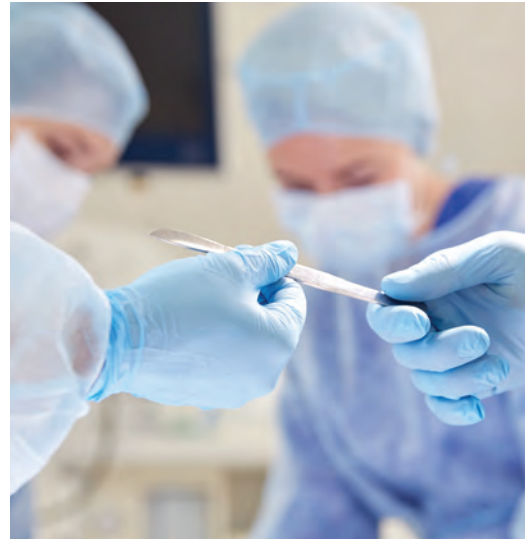
Bruce Power supplies Nordion with Cobalt-60 for industrial and medical use.

Industrial Cobalt-60

The first and most widely used type of Cobalt-60 is employed by industry to sterilize medical devices such as sutures, gloves and syringes. This type of Cobalt-60 is typically sourced from nuclear companies like Bruce Power and helps sterilize more than 40 per cent of the world's single-use medical devices.

Medical Cobalt

More precisely known as High Specific Activity (HSA) Cobalt-60, this is used worldwide for cancer treatment and radiation therapy for the treatment of complex brain conditions. This new source of Cobalt will ensure doctors and their patients have treatments when they need them and access to new and innovative machines. One of the technological advancements that will benefit from a stable supply of HSA Cobalt is the Elekta Gamma Knife® surgery, which uses an innovative tool that allows for non-invasive treatment of brain disorders — something that's very difficult and complex to do through conventional means. This method delivers a single, high dose of radiation to a small and critically located area in the skull, and is preferred for its extreme accuracy, efficiency and outstanding therapeutic response.



HSA Cobalt-60
cancer treatment
has been used
for more than
60 years to treat
an estimated
35 million
patients worldwide.



Stereotactic Radiosurgery using Cobalt-60 therapy allows doctors to deliver higher doses of radiation to tumours, while limiting damage to the surrounding healthy tissue and organs. For many brain cancers, Cobalt-60 therapy is one of the most precise and advanced forms of radiation treatment available.*

*Source: Stereotactic Radiosurgery, American Brain Tumor Association, 2012.

Gamma Knife Radiosurgery

Gamma Knife radiosurgery is a type of radiation therapy used to treat tumours and other abnormalities in the brain.

In Gamma Knife radiosurgery, specialized equipment focuses close to 200 tiny beams of radiation on a tumour or other target. Although each beam has very little effect on the brain tissue it passes through, a strong dose of radiation is delivered to the site where all the beams meet.

The precision of Gamma Knife radiosurgery results in minimal damage to healthy tissues surrounding the target. In some cases, Gamma Knife radiosurgery may have a lower risk of side effects compared with other types of radiation therapy. Also, Gamma Knife radiosurgery is often a safer option than traditional brain surgery.

Gamma Knife radiosurgery is usually a one-time therapy, completed in a single day.





University of
Alberta Hospital
Edmonton, AB



Winnipeg Health
Sciences Centre
Winnipeg, MN

Today, Gamma Knife surgery is
performed in hundreds of leading
hospitals and clinics around the world.

About 70,000 patients undergo Gamma Knife surgery every year, and this unique procedure has an impressive scientific track record.



Centre Hospitalier
Universitaire
de Sherbrooke
Sherbrooke, QC



UHN Princess Margaret
Cancer Centre, Sunnybrook
Health Sciences Centre &
Toronto Western Hospital
Toronto, ON

There are three Gamma
Knife machines in Ontario
and six in Canada.

GAMMA TECHNOLOGIES FOR THE MEDICAL INDUSTRY

Nordion's gamma expertise plays an important role in the health and well-being of the global population. Gamma is the technology of choice for sterilization by many of the world's leading medical device manufacturers. Its proven process is safe, reliable and highly effective.

Gamma irradiation, produced by Cobalt-60, emits high-energy gamma rays which disrupt living cells by damaging the DNA and other cellular structures. These changes at the molecular level cause death of organisms.

Sterilization of single-use medical devices

Gamma sterilization is a proven process that's highly effective at treating single-use medical devices. With the ability to penetrate products while sealed in their final packaging, gamma sterilization economizes the manufacturing and distribution process, while still ensuring full sterility of the product.

Sterilization of tissue-based devices

Sterilization of tissue-based devices by gamma irradiation is conducted routinely and is gathering momentum in the health care industry. Tissue-based devices come from human donors. There are no living cells in the bone grafts, tendons, ligaments and various other tissues. While not currently required by regulatory standards, tissue banks are choosing to terminally sterilize tissue-based devices with gamma in order to increase patient safety.

Sterilization means the use of a physical or chemical procedure to destroy all microbial life, including highly resistant bacterial endospores.

Sterilization of combination devices

A combination device is a medical device combined with a tissue or pharmaceutical or other component that falls within one or more regulatory standards, such as drug-eluting stents. Sterilization can affect drug properties and material properties, so sterilization by gamma irradiation is applied to ensure that the combination device's sterility and functionality are maintained.

Sterilization of implantable devices

Implantable devices include orthopedics (i.e. knees), stents, heart valves and more. Metal and polymers present a challenge to some sterilization modalities. Gamma is highly efficient for sterilization of implantable devices; in fact, the highest percentage of sterilization modalities for orthopedics is gamma. Additionally, many implantable devices are high value and therefore depend on a reliable process to ensure quality control and prevent the potential for lost product due to processing faults.

Sterilization of pharmaceuticals

Sterilization by gamma irradiation is advantageous for a wide range of pharmaceutical products. Due to the high demand in the pharmaceutical industry, gamma has proven itself to be an effective method as indicated by its acceptance in the European Pharmacopeia, and, more recently, drafted into the United States Pharmacopeial Convention. Some of the advantages of gamma over other modalities include high penetration power, isothermal character (small temperature rise) and no residues. It also provides a better assurance of product sterility than aseptic processing and lower validation demands.





GAMMA TECHNOLOGIES FOR FOOD IRRADIATION

Gamma is also used to disinfect certain food and consumer products such as spices and cosmetics, and eliminate invasive insect pests from tropical produce prior to export to various countries.

While some methods leave traces of toxic substances, gamma rays do not. The rays are highly effective at killing micro-organisms and insect pests, yet there is no residue or radioactivity on or in the products and packaging. This means no quarantine is required and product is immediately available for shipment or use after processing.

Agriculture industry, spices and food

The American Spice Trade Association provides guidance on the use of irradiation as a microbial reduction strategy for spices.

In some countries, regulatory requirements and consumer demands are restricting the use of chemical treatments required for export of fruits and vegetables. The growing awareness of the dangers of chemicals that are known carcinogens has led countries to review and, in some cases, suspend their use. These and other drivers have resulted in an increase in irradiation of food products as an alternative to chemical treatments.



From pepper to paprika and basil to parsley, many spices are disinfected using gamma. Gamma prevents food-borne illnesses caused by micro-organisms, without affecting the taste of the spices.





Gamma irradiation is also used to treat meat and produce against micro-organisms such as E.coli and salmonella. Irradiation is for the safety of consumers and neither changes the taste nor the nutrient levels of the food.



DISEASE PREVENTION

A team of experts at the International Atomic Energy Agency (IAEA) are launching a new fight against Zika and it's totally nuclear. It is estimated over one million people have already been affected by the Zika virus, and an estimated 2.2 billion live in 'at risk' areas.

Sterile Insect Technique (SIT) is a process aimed at eliminating or, at a minimum, suppressing the population of insects that spread disease or damage agricultural crops. SIT poses no risk to the environment or to public health and, in fact, is considered one of the most environmentally friendly insect pest control methods ever developed because the insects are not self-replicating and do not become established in the environment.

With nuclear technology as part of the formula, science may be able to stop the spread of what could soon be a global epidemic.



Each year,
insects destroy
an estimated
10 per cent of
global harvests.
In developing
countries, this
figure has
been put as
high as 25 to
35 per cent.

* Source: World Nuclear Association



THE BLUE GLOW

When not in use, Cobalt-60 is placed in a pool of de-ionized water, which acts as a shield from the radiation.

The radiation gives off a blue glow underwater, known as the Cherenkov Effect, named after the Russian scientist who studied the phenomenon. It's caused by charged particles travelling faster than the speed that light normally travels through water. The blue glow is the optical equivalent of a sonic boom.



Resources

World Nuclear Association <http://world-nuclear.org>

World Health Organization <http://www.who.int/en/>

Nordion <http://www.nordion.com/>

Centre for Disease Control <http://www.cdc.gov/>

Mayo Clinic <http://www.mayoclinic.org/>

www.cleannuclearpowersafehospitals.com

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