Betalight™

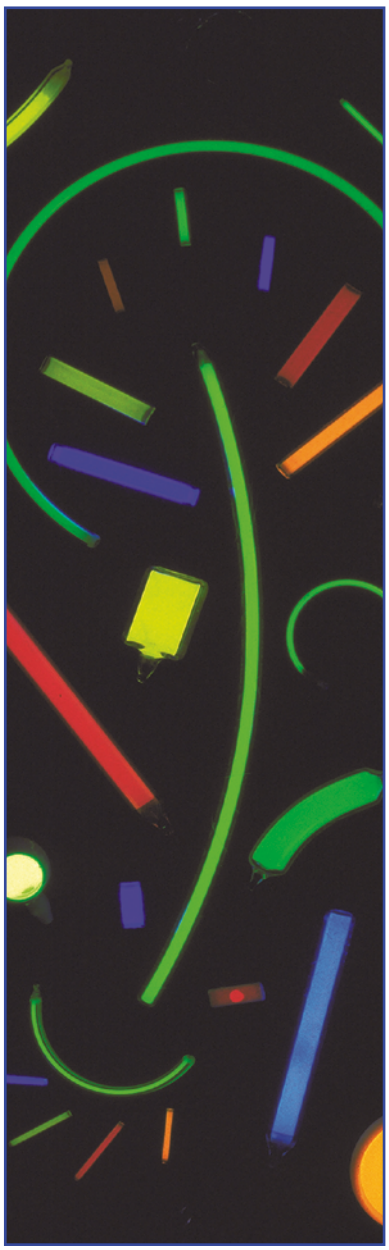
WWW.SRBT.COM

SRBT ISO 9001

May 30, 2025 - ISSUE 28

Company Background

- SRB Technologies (Canada) Inc. (SRBT) has been in operation since 1990 and is located at 320 Boundary Road in Pembroke.
- Our company is locally owned and currently employs 39 hard working local residents.
- In June 2022 the Canadian Nuclear Safety Commission (CNSC) renewed SRBT's Class 1B Nuclear Substance Processing Facility Operating Licence for a period of 12 years.
- We are totally committed to protecting the local environment, our employees, the public and to meeting the safety requirements of the CNSC. We will continue to be transparent, visible and open with our community and regularly provide information to the public.

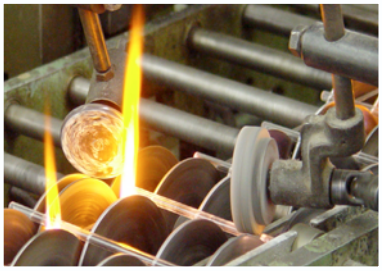


What is a Betalight™?

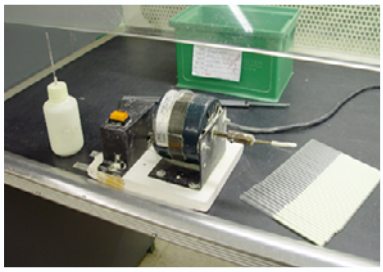
- All products manufactured and designed by SRBT use Betalights™.
- A Betalight™ is a sealed glass capsule internally coated with a phosphorescent powder and filled with a radioactive gas called tritium to produce continuous light.
- First developed in the 1960's, Betalights™ were initially deployed within the defense and transportation industries (ie: backlighting of instrument panels and switch lighting).
- They can be manufactured in a variety of shapes, sizes and colours.
- By using varying amounts of tritium, the brightness of the Betalight™ can be controlled as well as the life time for the Betalight™ to produce a desired or required brightness.

How does a Betalight™ Generate Light?

- When tritium decays, an electron is emitted from the nucleus.
- The electron is a source of energy that interacts to energize a phosphorescent powder which produces light.
- This is achieved by positioning the phosphorescent powder in close proximity to the gas, enabling the electrons to interact with the powder, causing it to emit photons. These photons of light energy are like those in a TV picture tube or a computer monitor, but instead use the energy of the electrons emitted from the tritium rather than from electricity.
- These electrons, or beta particles, emitted by the decay of tritium can only travel short distances in air (about 4.5 mm). The electrons do not have sufficient energy to penetrate even a single sheet of paper. It is therefore essential that the gas is in close proximity with the phosphorescent powder so that the electrons can interact. This is achieved by placing the powder on the inside surface of the glass capsule where it can be readily energized.

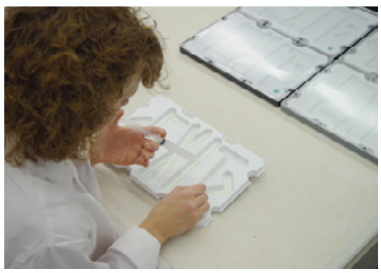


Glassblowing

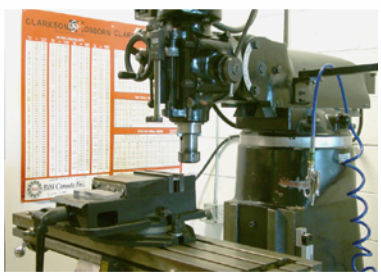


Coating

Tritium Processing



Assembly



Machining

Why Choose Betalights™?

- Betalights™ are absolutely reliable, fail safe, require no maintenance and do not need electricity, power, batteries or wiring.
- Betalights™ are a continuous light source and do not require ambient light for charging.
- Betalights™ are compatible with night-vision equipment.
- Betalights™ are extremely lightweight and compact and are highly suitable for portable equipment.
- Betalights™ are maintenance-free during a long service life of up to 20 years.
- Betalights™ will continue to operate normally in temperatures ranging from -70˚C. to 100˚C and in high humidity, even when immersed in water.
- Betalights™ do not produce electrical noise and are safe for use in hazardous areas.
- Betalights™ make useful contributions to energy conservation.

Description of Manufacturing Processes

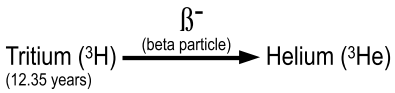
- Our products are manufactured to strict procedures audited on a regular basis by a number of independent third parties.
- Our company is ISO 9001 registered, ensuring all processes are performed in an organized, controlled and repeatable manner.
- Any radioactive waste generated from the facility is disposed to a CNSC licensed waste facility or by other means with the approval of the CNSC.
- During the manufacturing process small quantities of tritium are released into the environment through our two exhaust stacks.
- Tritium is our single largest cost and precautions are taken during manufacturing to ensure emissions to the environment are minimized.
- Tritium released per week has dropped significantly from 23,546 GBq/week in 2005 to 882 GBq/week in 2024, a decrease of just over 96%.

Outline of Company Products

- Our products are maintenance free and work without batteries and electricity and are widely used in areas where power is not readily available. Our signs are used to illuminate the way in various commercial buildings, mines and sewer systems. SRBT also manufactures many illuminated products for the Canadian, American and British military. Our products are also installed in a number of aircraft to illuminate escape doors and routes.
- The energy emitted from tritium does not penetrate the Betalights™, so there is no external radiation hazard from our products.
- The Betalights™ within each device and the devices themselves are thoroughly tested to minimize the possibility of breakage.
- In the unlikely event that an exit sign containing 20 curies of tritium is broken, the dose to an individual is expected to be less than the annual public dose limit set by the CNSC of 1.0 millisievert (mSv) and would depend on the amount of tritium left in the device and the size and ventilation of the room where the device is broken.

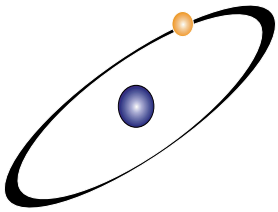
Beta Radiation

- Beta Radiation is an electron emitted by an unstable nucleus. It does not normally penetrate beyond the top layer of skin.[6]



Tritium

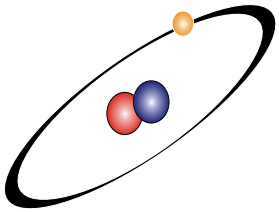
- Tritium is a colorless and odorless radioactive isotope of hydrogen.[1]
- People are exposed to small amounts of tritium every day, since it is widely dispersed in the environment and in the food chain.[1]
- Tritium is a relatively weak source of beta radiation and is produced naturally and also produced as a by-product of electrical generating stations. Tritium is also used in studies investigating the safety of potential new drugs.[1]
- Tritium enters the body when people swallow tritiated water, and may also enter the body when people inhale tritium as a gas in the air, and absorb it through their skin.[1]
- Once tritium enters the body, it disperses quickly and is uniformly distributed throughout the body. Tritium is excreted through the urine within a month or so after ingestion.[1]



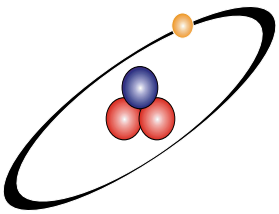
Hydrogen ^{1}H
1 electron
1 proton

Effects on the Environment and the Public

- Based on monitoring results, at MAXIMUM, the dose to a child or adult due to SRBT would be 0.0026 mSv/year, much less than 1% of the public dose limit of 1.0 mSv/year. This assumes this child or adult resides very close to SRBT, breathing air due to the emissions from SRBT, drinking well water or formula mixed with well water and assuming 100% of their produce and dairy consumption is from local sources.
- Below 50 to 100 mSv, which includes occupational and environmental exposures, risks of health effects are either too small to be observed or nonexistent.[2]
- The International Commission of Radiological Protection (ICRP) have attempted to determine the probability of fatal and non-fatal cancers, and hereditary effects from any dose of radiation. The probability in total is 0.000073 per mSv.[3] Therefore one out of approximately 5 million people could possibly develop these effects if every individual received a dose of 0.002 mSv.
- The Financial Guarantee is fully funded by SRBT should the facility ever need to be decommissioned in the future. As of the end of 2024, $785,412.80, or 108% of the required $727,327.00 is in place in a secure escrow account.



Deuterium ^{2}H or D
1 electron
1 proton
1 neutron



Tritium ^{3}H or T
1 electron
1 proton
2 neutrons

Effects	Detriment (per mSv)
Fatal cancer	0.000050
Non fatal cancer	0.000010
Severe hereditary effects	0.000013
Total	0.000073 [3]

Groundwater

- SRBT's groundwater study includes monitoring data from 57 wells drilled to various depths and 31 wells are located within 150 meters of our facility.
- The contamination of groundwater is at a level that does not pose a risk to any member of the public.
- The decrease in emissions together with natural decay will reduce tritium concentrations in groundwater over time.
- In 2024, tritium concentrations in wells used for some drinking water ranged from 4 Bq/L to 763 Bq/L, which is less than 11% of the Ontario Drinking Water Guideline of 7,000 Bq/L.

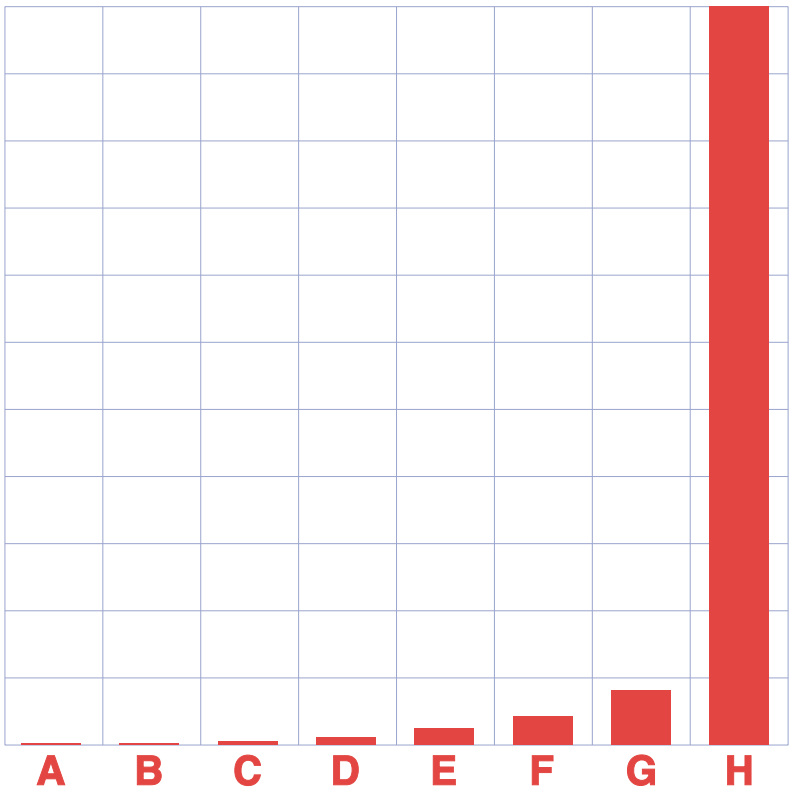
Monitoring

WHAT IS MONITORED CURRENTLY	FREQUENCY
Facility stack emissions	Continuous
40 air monitoring stations	Every Month
8 precipitation monitors	Every Month
Muskrat River	Every Month
29 monitoring wells	Every 3 Months
7 residential and business wells	Every 6 Months
Local Milk	Every 6 Months
Sludge samples	Every 6 Months
Locally grown produce	Once a year
6 facility downspouts	Random

Note: All results are communicated to the CNSC and available in our Annual Compliance Reports which are posted on our website.

Public Dose in Perspective

mSv		
100.00	H	994 out of 1000 individuals exposed to 100 mSv would not develop cancer.[4] Risk of disease or death is increased by 10% among those who receive 100 mSv.[5] (H on Graph)
7.00	G	Brain Scan.[6] (G on Graph)
1.80	F	On average, public radiation exposure in Canada due to all natural sources.[7] (F on Graph)
1.00	E	CNSC annual public dose limit. (E on Graph)
0.52	D	The highest dose to an SRBT employee (in 2024). (D on Graph)
0.50	C	Abdomen X-Ray (C on Graph)
0.067	B	The average dose to SRBT employees (in 2024). (B on Graph)
0.0026	A	Maximum annual dose to the public due to SRBT (in 2024). (A on Graph)



Natural Radiation

Cosmic Radiation

- Cosmic rays are mainly protons of uncertain origin in space and very high energies that reach our atmosphere in fairly constant numbers. The annual effective dose from cosmic rays at ground level is about 0.4 mSv, on average. Most people live at low altitudes, and so experience similar annual doses from cosmic radiation. However, in some areas at considerable altitude for example, Denver in the Rocky Mountains, residents may receive annual doses several times higher than those people living at sea level.[6]

Gamma Radiation

- All materials in the Earth's crust contain radionuclides. Energy from natural activity deep in the Earth contributes to the shaping of the crust and the maintenance of internal temperatures. This energy comes mainly from the decay of the radioactive isotopes of uranium, thorium, and potassium. The average effective dose from natural gamma rays is about 0.5 mSv in a year. Actual values vary appreciably and some people may receive doses a few times higher or lower.[6]

Radon inhalation

- Radon gas is a particularly significant source of exposure to natural radiation. If buildings are well ventilated this accumulation of radon will not be marked. However, in many generally colder countries, buildings are constructed with more emphasis on retaining heat and preventing draughts. They are, therefore, often poorly ventilated, and radon concentrations indoors can be many times higher than those outdoors. Radon concentrations in buildings are also very dependent on the local geology and can vary a great deal between different parts of a country and even from building to building in the same area. The worldwide average annual effective dose from the decay products of radon is estimated to be about 1.2 mSv. In some countries the national average is several times higher.[6]

Internal irradiation

- Other radionuclides from the uranium and thorium series, in particular lead-210 and polonium-210, are present in air, food and water and therefore irradiate the body internally. Potassium-40 also comes into the body with the normal diet. The average effective dose from these sources of internal radiation is estimated to be 0.3 mSv in a year.[6]

Total Dosage Due to Natural Radiation

- The total worldwide average effective dose from natural radiation is about 2.4 mSv (1.8 mSv in Canada[7]) in a year, but doses can vary a great deal.[6]

Source	Worldwide average dose (mSv)	Typical range dose (mSv)
Cosmic radiation	0.4	0.3 to 1.0
Gamma radiation	0.5	0.3 to 0.6
Radon inhalation	1.2	0.2 to 10
Internal irradiation	0.3	0.2 to 0.8
Total (rounded)	2.4	1.0 to 10

Other Than Natural Radiation

Diagnostic radiation

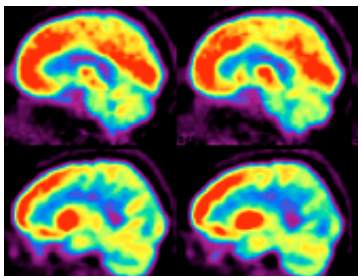
• In a conventional X ray examination, radiation from a machine passes through the patient.[6]

Examination	Conventional x-ray Dose (mSv)
Head	0.07
Teeth	less than 0.1
Chest	0.1
Abdomen	0.5
Pelvis	0.8
Lower spine	2
Lower bowel	6
Limbs and joints	0.06

Nuclear medicine

• For a diagnostic procedure in nuclear medicine, the patient is given a radionuclide in a carrying substance, such as a pharmaceutical, which is preferentially taken up by the tissue or organ under study. Administration may be by injection, ingestion, or inhalation. The radionuclide emits gamma rays.[6]

Organ scan	Effective Dose (mSv)
Brain	7.0
Bone	4.0
Thyroid, lung	1.0
Liver, kidney	1.0



Air travel

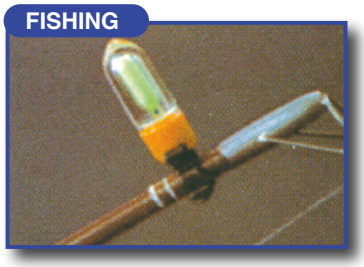
• Exposure to passengers and crew due to cosmic radiation.[6]

Cities	Effective Dose (mSv)
Vancouver to Honolulu	0.0142
Montreal to London	0.0478
Helsinki to New York	0.0497
London to Tokyo	0.0670
Paris to San Francisco	0.0849

Reference Documentation

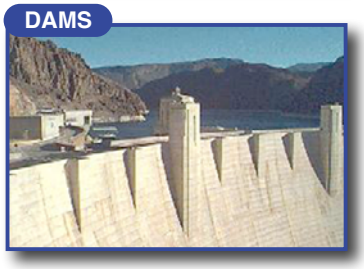
1. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, TRITIUM, https://www.epa.gov
2. HEALTH PHYSICS SOCIETY, Radiation Risk In Perspective, Richard J. Burke Jr., Executive Secretary Health Physics Society, http://hps.org
3. ICRP PUBLICATION 60, 1990 Recommendations of the International Commission of Radiological Protection,PERGAMON PRESS
4. HEALTH PHYSICS SOCIETY, Answer to Question #4703 Submitted to “Ask the Experts”, http://hps.org
5. Risk of cancer after low doses of ionising radiation - British Medical Journal, June 29, 2005, https://www.bmj.com
6. INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation, People and the Environment, https://www.iaea.org
7. http://nuclearsafety.gc.ca/eng/resources/radiation/introduction-to-radiation/radiation-doses.cfm

FISHING



THEATRES

DAMS



STAIRWAYS

HELICOPTERS

TUNNELS

TANKS

MINE CLEARING

TROOPS

MILITARY AIRCRAFT

MARKERS

MILITARY VEHICLES

Community Information

Support for Our Community

SRBT and its staff continue to support the local community by providing support to various organizations and causes:

- Pembroke Horticultural Society
- St. Joseph's Food Bank
- Festival Hall
- Local Baseball Team
- Local Ball Hockey League
- Local Hockey Team
- Local Softball Team
- Christmas Angels Program
- Alice & Fraser Horse Association
- Local Youth Basketball Team
- Gold Sponsor for Local Memorial Softball Tournament
- Pembroke Fire Department Chili Fest
- Renfrew County Regional Science and Technology Fair
- Robbie Dean Family Counselling
- Two Local Fishing Derbies

For further information on tritium and radiation hazards, please visit the third party sites listed below:

- **Canadian Nuclear Safety Commission:** *https://www.cnsc-ccsn.gc.ca*
- **United States Environmental Protection Agency:** *https://www.epa.gov*
- **International Atomic Energy Agency:** *https://www.iaea.org*
- **International Commission on Radiological Protection:** *http://www.icrp.org*
- **Health Physics Society:** *http://hps.org*
- **International Agency for Research on Cancer:** *https://www.iarc.fr*

For more information or if you are interested in a plant tour, please contact:

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For further information please visit: http://www.srbt.com
Or follow our Facebook, Instagram, X, LinkedIn, Reddit & TikTok accounts.

Radiation measurements

are often represented in various units and can cause confusion:

PRESCRIBED LIMIT TO PUBLIC = 1 mSv

1 mSv = 0.001 Sievert
1 mSv = 1,000 microSievert (μSv)
1 mSv = 1,000,000 nanoSievert (nSv)
1 mSv = 1,000,000,000 picoSievert (pSv)

ONTARIO DRINKING WATER GUIDELINE = 7,000 Bq/Litre

7,000 Bq/L = 7 Bq / millilitre
7,000 Bq/L = 7,000,000 milliBecquerels (mBq)/Litre
7,000 Bq/L = 7, 000,000,000 microbecquerels (μBq)/Litre
7,000 Bq/L = 0.000000189 Ci / Litre

RADIOACTIVITY IN KNOWN MATERIALS [5]

1 kg of coffee = 1,000 Bq
1 household smoke detector = 30,000 Bq
1 kg of coal ash = 2,000 Bq
1 kg of granite = 1,000 Bq

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