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Written submission from Anna Tilman

Exposé oral

Mémoire de Anna Tilman

In the Matter of the

À l'égard de

SRB Technologies (Canada) Inc.

SRB Technologies (Canada) Inc.

Application for the renewal of the licence for SRBT Facility

Demande de renouvellement de permis pour l'installation de SRBT

Commission Public Hearing

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Canada

Submission to the Canadian Nuclear Safety Commission (CNSC)

with respect to

SRB Technologies (Canada) Inc.'s

Application for Renewal of its Class 1B Operating Licence for a 15-year period

April 27, 28 2022

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Table of Contents

SRBT FACILITY – LICENCE APPLICATION REQUEST

SRB Technologies (Canada) Incorporated (SRBT) is a gaseous tritium light source manufacturing facility located in an industrial park in the southern part of Pembroke, Ontario, approximately 150 km northwest of Ottawa. It is situated in the proximity of the traditional and treaty territories of many Indigenous Nations and communities. The area surrounding SRBT is mainly used for industrial and commercial purposes. The closest residences are located in a small residential area approximately 250 metres to the west and north-west of the facility.

Tritium light source technology was originally developed several decades ago in the United Kingdom by the precursor of SRBT. The Pembroke facility began operating in 1990 under a licence issued by the Atomic Energy Control Board. These operations involve the processing of tritium for manufacturing self-luminous safety signs and devices. In 2012, SRBT became 100% Canadian-owned and operated. Its current workforce numbers about 38-40 employees.

SRBT Operations

Tritium is the one radioisotope used by SRBT. The company processes tritium gas to produce Gaseous Tritium Light Sources (GTLS) and radiation devices containing GTLS. These products are distributed in Canada and internationally.

SRBT's current operating licence allows it to:

- Operate a Class IB facility, comprising of a tritium processing facility for the purposes of manufacturing radiation devices.
- Produce, possess, transfer, service and use, radiation devices arising from the manufacturing of radiation devices.
- Possess, transfer, use, process, manage, store and dispose of nuclear substances that are required for, associated with, or arise from the manufacturing of radiation devices.
- Possess tritium up to a limit of 6000 Terabecquerels (TBq) of tritium in any form.
- Possess and use prescribed information that is required for, associated with, or arise from the manufacturing of radiation devices.

SRBT's Licence Length Request

The current licence is due to expire on June 30, 2022. SRBT has applied for a 15-year licence renewal (from July 1, 2022 to June 30, 2037) to allow it to continue its operations.

With respect to its request, SRBT indicates that:

"The stability offered by a fifteen-year licence would also further ensure SRBT's ability to **secure long term contracts with customers and suppliers**. The company further states that based upon its performance, its continued commitment to operating the facility safely, and improving our operations continuously, SRBT believes that a licence term of fifteen years would be reasonable, beneficial, appropriate and justified."[1]

[1] CMD22-H8.1 p.15

The length of the licence request is controversial and highly questionable, especially in light of the history of SRBT regarding excessive emissions of tritium for a number of years.

> Can one presume or assume that issues regarding the level of releases of tritium to air, wells, groundwater, and sewers will continue as they have, and not be appropriately addressed?
>
> Will the concomitant issue of the disposal radioactive waste continue under the adoption of clearance levels for radioactive waste, thus allowing for the disposal of tritium-laden material in landfills not designed for radioactive material?
>
> Can it necessarily be assumed that the demand for tritium signs, lights, and other tritium-containing products continue unabated or even increase? Some jurisdictions (the US for example) have serious concerns with tritium lights and signs etc., in particular with respect to breakage and ultimately their disposal.

The use and production of these light sources and radiation devices over the years has resulted in very sizeable emissions of tritium to air, water, groundwater and ultimately in disposal sites. Indeed, the allowable limits of tritium releases set by the Canadian Nuclear Safety Commission (CNSC) are so “liberal” that this company has been virtually given a free pass on its operations. This is unacceptable and cannot be ignored. Unfortunately, it has been ignored far too long. Too much damage has already been done. It will take decades for the present levels of tritium in the various media in the Pembroke area and beyond to decay to the point at which these levels would be negligible.

A licence period of 15 years, as requested by SRBT, cannot and must not be granted by the CNSC. If the CNSC were to do so, then it is allowing for unprecedented permissive levels of tritium to continue to be emitted in air, water and be disposed of in landfills for a very long period with impunity.

It is the responsibility and duty of the CNSC to ensure public safety and protection of the environment from radionuclides. The information and commentary presented in this submission are intended to highlight the problems and issues emanating for the operations of SRBT and will argue that this facility should be and must be closed down. There is no alternative.

The following sections of this submission deal with several issues with respect to the operations at SRBT resulting from continuing the operations of SRBT. The fundamental issues reside with past processes in the production of Gaseous Tritium Light Sources (GTLS) and radiation devices, the long-term legacy of the use of tritium and the resulting contamination of air, water and groundwater, the “disposal” of tritium-laden devices in landfills, as well as other issues and practices that have left a long and deep mark resulting from SRBT’s operations.

It is important to address these matters, because of their potential and continuing impact on the environment that would only perpetuate if SRBT were to continue to operate according to their planned re-licensing request.

TRITIUM - OVERVIEW

Tritium is a radioactive isotope of hydrogen that occurs naturally in the environment, mainly due to nuclear reactions induced by high-energy cosmic rays in the upper atmosphere. Its half-life is approximately 12.3 years, and upon decay emits a beta particle of very low energy as it transmutates to stable Helium-3.

Tritium is also produced artificially as a by-product in nuclear reactors. During their operation, tritiated water accumulates in reactor process fluid systems. It is removed and converted into diatomic molecular tritium gas by Ontario Power Generation at the Tritium Removal Facility in Darlington, Ontario. The tritium gas is immobilized and stored as a metal tritide, and then made commercially available to customers such as SRBT.[2]

MANUFACTURING PROCESS - GASEOUS TRITIUM LIGHT SOURCES (GTLS)

Gaseous tritium light sources (GTLS) are comprised of borosilicate glass capsules that have been internally coated with a thin layer of phosphorescent zinc-sulfide powder. When excited by electrons, certain formulations of this powder emit characteristic wavelengths of light that can be detected by human eyes.

The SRBT facility processes and incorporates tritium gas into the coated glass capsules. The phosphorescent powder becomes excited by the beta particles emitted by tritium as it decays. This results in a continuously illuminated light source that requires no energy input in order to remain lit.

The initial brightness of a GTLS is directly correlated to the amount of tritium gas inside the light. Over time, the light source will become dimmer at a characteristic rate as the tritium gas decays, necessitating replacement if a minimum brightness is required for a specific application.

Safety devices that use GTLS have life spans ranging up to 20 years, depending on the model of the device. SRBT offers a service to take back expired safety signs and devices containing GTLS, "in order to safely process and either repurpose or safely dispose of the light sources."[3]

According to SRBT, thousands of shipments containing radioactive material have been safely shipped and received during the current licence period.

While SRBT states that facility security has been continuously maintained, with no security-related incidents or issues throughout the licence term, that has not necessarily been the case. In fact, there have been incidences with shipments, ranging from a stolen truck containing tritium signs, to mix-ups in destinations and delivery (Refer to Events in this submission for the current licence period).

[2] CMD 22-H8.1 p.8,9
[3] Ibid p.9

TRITIUM – THE STANDARDS

Overview

Tritium is one of the major radioactive contaminants released to air and water by nuclear facilities. In particular, it is the only radionuclide used by SRBT.

SRBT has been in operation for just over thirty years. If the company is re-licensed to continue its operations for a period of 15 years (until the year 2037), levels of tritium will continue to be released to air, water, sewers, etc., for years to come. However, it is not just yearly emissions of concern, but given the half-life of tritium of 12.3 years, it is the cumulative impact of these emissions over several decades that are of concern.

Both gaseous and aqueous forms of tritium (HT and HTO respectively) are very radioactive and pervasive. The gaseous form (HT) permeates most materials, including rubber and many grades of steel, with relative ease. Because the aqueous form (HTO) is chemically and physically identical to ordinary water, it rapidly mixes everywhere.

Tritium is absorbed through inhalation, ingestion and dermal absorption, inhalation being the most dangerous route. Once absorbed into the body, it can become incorporated into DNA, where it can give rise to cancers and cause hereditary defects and other diseases. Because tritium crosses the placenta easily, it can contribute to spontaneous abortions, stillbirths, and congenital malformations. When tritium spontaneously disintegrates, the resulting recoil excitation can disrupt chemical bonds which can cause chronic diseases such as allergies or hormonal dysfunction.[4]

One of the serious difficulties in dealing with tritium exposures in the workplace and elsewhere is the ease and rapidity with which it moves in and out of all biological entities, including humans. Another issue is the technical difficulty in measuring tritium once inside the body.

Relative Biological Effectiveness (RBE) of Tritium – Drinking Water Standards

The RBE is an indication of the amount of damage caused in biological tissue by a given type of radiation. Drinking water standards and workplace exposure limits for tritium have been set based on the assumption that the RBE of tritium has a value of 1, the same as that for gamma rays. Other forms of radiation, for instance, alpha particles, have an RBE of 20.

CNSC continues to rely on the current Canada Guideline and Ontario Drinking Water Quality Standard for tritium of 7,000 Bq/L as being “safe”, despite recommendations dating back to the 1990s that this level be reduced to 20 Bq/L.[5]

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[4] http://iicph.org/files/health-effects-of-tritium.pdf (Dr. Rosalie Bertell)

[5] Ontario Drinking Water Advisory Council, *Report and Advice on the Ontario Drinking Water Quality Standard for Tritium* (Toronto: ODWAC, 2009) http://www.odwac.gov.on.ca/reports/052109_ODWAC_Tritium_Report.pdf; Canadian Environmental Law Association, *Comments to the Ontario Ministry of the Environment Regarding the Proposal to Adopt the Canadian Drinking Water Quality Guideline for Radiological Characteristics as an Ontario Drinking Water Objective for Radionuclides* (Toronto: CELA, October 1999). See also Canadian Environmental Law Association “Proposed Tritium Drinking Water Standard Too High Say Groups” (October 26 1999).

This recommendation is based on the health effects from long-term, chronic exposure over a lifetime of 70 years, and limits the lifetime risk to about one excess fatal cancer per million people. This matches the current Canadian Federal (and Provincial) limit for chemicals, which is set at levels that provide a lifetime risk of 1-10 excess fatal cancers per million people.

The current drinking water guideline of 7,000 Bq/L allows for 350 excess fatal cancers per million people over a lifetime. The risks used to determine standards for radioactive substances in Canada, such as for tritium in drinking water, must be at least as stringent as the standards for non-radioactive chemicals.

The current value established for the RBE for tritium is such a severe underestimation. In fact, it is an embarrassment and travesty! If it were set at a precautionary level to reflect the issues with exposure to tritium then all exposure standards for tritium would have to be adjusted accordingly, and a new drinking water standard would appropriately reflect the impact of tritium on the human body, unlike the current standard which is only established to suit the need of the nuclear industry.[6]

Ultimately, and ideally, there should be no tritium in drinking water.

RADIOACTIVE WASTE MANAGEMENT – DISPOSAL AND "CLEARANCE"

The routine processing of tritium for the purposes of manufacturing gaseous tritium light sources and devices results in the generation of tritium-contaminated waste materials. In order to manage these materials effectively and safely, SRBT implemented and maintains a waste management program that was submitted as part of their application for a licence renewal.

SRBT's Waste Management Program includes a set of procedures aimed at ensuring that the waste is minimized, appropriately classified and segregated, characterized for hazards, stored and processed safely, and cleared or managed in accordance with regulatory requirements.[7]

Waste materials characterized as being contaminated to levels that exceed "conditional clearance levels" are disposed of through licenced radioactive waste management service providers.

Conditional clearance levels were initiated in 2015 as a means of a management strategy to deal with what is deemed to be very mildly-contaminated radioactive materials.[8] The so-called "cleared" waste is considered no longer radioactive and thus can be "free-released", that is, dispersed to landfills and recycling streams without public knowledge or consent and no means of tracking it.

The application of clearance levels is highly disconcerting, in that it effectively is allowing material contaminated with tritium to be deposited in landfills without protective measures, etc., and thus without proper accounting or protection for the environment. This practice

[6] http://tapcanada.org/wordpress/wp-content/uploads/cerrie-report-on-tritium.pdf

[7] CNSC document CMD 22-H8 p.55-57

[8] SRBT CMD 22-H8.1 p. 73,74 (CSA N292.5-11, *Guideline for the exemption or clearance from regulatory control of materials that contain, or potentially contain, nuclear substance*). Ref: http://laws-lois.justice.gc.ca/eng/regulations/SOR-2000-207/page-14.html

removes responsibility and liability from the nuclear industry and the government to properly account for releases of radioactive material in waste. It is a dubious and devious means of reducing radioactive active waste as though such waste never even existed, and fails to protect public health and safety.

Only to add to the issue of the disposal of radioactive waste, in addition to manufacturing radiation devices in the form of tritium-powered self-luminous safety signs, SRBT offers end-users a service for the return of expired or otherwise disused devices for management. As part of this service, **SRBT dismantles devices that contain tritium light sources, so that the light sources may be either safely re-used, or managed through a licensed radioactive waste service provider as low-level radioactive waste.** Accordingly, by dismantling these devices and removing the light sources, the mass and volume of low-level radioactive waste generated is "minimized".

SRBT does detail the number of expired tritium safety signs and devices processed, and the amount of low-level radioactive waste generated and "safely managed" in their annual compliance reports submitted to the CNSC.

Over the course of the current licence term, SRBT processed over 150,000 tritium safety signs from various manufacturers. Somehow, the company regards this as ensuring a closed-loop life cycle for the tritium light sources used in their products.

CNSC staff have reviewed SRBT's Waste Management Program and find it to be satisfactory. Unfortunately, this is not the case.

From a health and environmental perspective, SRBT's waste management plan is fraught with issues. By allowing for conditional clearance, the amount of "low-level" radioactive material generated and routed to a licences waste management facility in one year alone, let alone for many years yet to come, means that the cumulative impacts that this waste will have is not being considered or taken into account. Nor is there any recognition of the half-life of tritium, 12.3 years. So the radioactive waste keeps piling up with time, as relatively little will decay.

RADIOACTIVE WASTE CONSIGNMENTS – 2020 [9]

Thirteen shipments of low-level waste (LLW) were made to Canadian Nuclear Laboratories (CNL) this year alone. All thirteen shipments included expired gaseous tritium light sources. As stated in this Annual Compliance and Performance Report:

> The implementation of Conditional Clearance Levels for waste materials has continued to be successful in reducing the amount of waste material that is needlessly disposed of as radioactive waste. SRBT continues to offer return and disposal services to customers who possess expired tritium-illuminated devices, such as 'EXIT' signs.
>
> In 2020, a total of 34,081 expired (or otherwise removed from service) self-luminous safety 'EXIT' type signs were accepted by SRBT from Canadian and American sources, representing

[9] 2020 Annual Compliance Report – p. 19, 148-9, 152.

a total activity of 6878 TBq of tritium.[10] (As a comparison, in 2019, a total of 28,073 signs were processed representing 5,144.93 TBq of tritium.)

An additional 179.69 TBq of tritium was accepted from international origins (i.e. other than Canada and the United States) in the form of expired tritium illuminated devices, such as aircraft signs, dials, gauges and other smaller equipment. These were also processed for shipment to a licenced waste management facility.

There is an apparent supposition that expired signs would be disassembled safely and the light sources removed, to ensure that the volume of low-level radioactive waste generated is minimized and thus be shipped to a licenced radioactive waste management service provider.

It is worth noting that the U.S. Nuclear Regulatory Commission (NRC) requires proper accounting and disposal of tritium signs of all radioactive materials, which includes unwanted or unused signs, because a damaged or broken sign could cause radioactive contamination of the immediate vicinity, requiring a potentially expensive clean up.[11]

THE MINIMIZATION OF RADIOACTIVE WASTE - CLEARANCE LEVELS

As a means of dealing with the sheer volume of materials contaminated with "low-level" radioactive waste, governments and nuclear agencies have developed policies that "clear" materials with low levels of radioactive contamination from regulatory control if they meet criteria referred to as "clearance levels".

This "cleared" waste is then treated as no longer radioactive and can be "free-released", that is, dispersed freely to landfills, recycling streams and even commercial and consumer products, without public knowledge and no means of tracking it, thereby avoiding accountability.

By instituting clearance levels, the nuclear industry has "minimized" its quantity of radioactive waste while making it available in the marketplace, without informed public knowledge and/or consent. This practice removes responsibility and liability from the nuclear industry and the government to properly account for releases of radioactive waste.

The deregulation of some low-level radioactive waste material and clearance levels of radionuclides has been in place in Canada under the *Nuclear Substances and Radiation Devices Regulations* (NSRDR) for several years. It is also widely practiced by other countries.
Ref: http://laws-lois.justice.gc.ca/eng/regulations/SOR-2000-207/page-14.html

It is a dubious and devious means of reducing radioactive active waste as though such waste never even existed. Above all, the use of clearance levels fails to protect public health and safety and the environment. It is an abject rejection of responsibility of the government and the nuclear industry.

[10] Ibid p. 149 – total activity of tritium stated was 5,360.02 TBq. Total activity using Table 35 p. was 6878 TBq.
[11] https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/fs-tritium.html

Proposed Improvements [12]

In their licence application, SRBT initially committed to revise the waste management program and bring it into compliance with the following CNSC Regulatory Document and CSA Group standard by December 31, 2021: REGDOC-2.11.1, *Waste Management, Volume I: Management of Radioactive Waste*, and CSA N292.0-19, *General principles for the management of radioactive waste*. SRBT has revised its commitment and will incorporate the aforementioned documents along with the recently published CSA N292.8-21 *Characterization of radioactive waste and irradiated fuel* [44] into their Waste Management Program by December 31, 2022.

No reason was provided for this delay. Consequently, without having details as to the potential revision, no comments can be made as to the potential revision of SRBT's waste management program. This is an example of another weakness in SRBT's licence application, as any changes would ensue after the fact. Thus, for CNSC to conclude that SRBT's Waste Management Program meets the applicable regulatory requirements is an a priori conclusion without merit. Unfortunately, it is indicative of the manner in which such waste is being "treated".

REPORTING EVENTS - PUBLIC ACCOUNTABILITY

CNSC Requirements

Since 2003, Nuclear Power Plant operators are required to submit "Event Reports", known as S-99 Reports, to the CNSC on a yearly basis under the S-99 regulatory standard.[13] The regulatory document, REGDOC-3.1.1, *Reporting Requirements for Nuclear Power Plants* replaced the S-99 regulatory standard as of June 2015.[14] The requirements under this regulation set out the timing and information that nuclear facility licensees are required to report to the CNSC to support the conditions of their operating licences, similar to the S-99 regulations.

Accordingly, for every "reportable" event a nuclear facility must file a full report that provides details regarding the event, including the effects on the environment, the health and safety of persons, and the maintenance of security that has resulted or may result from the situation, as well as the actions that the facility has taken or proposes to take with respect to the reportable event.[15]

The regulation also states that "Licensees should use the situation or event reporting according to this regulatory document as an input to their public disclosure protocol."[16]

However, there are limitations as to what is considered a reportable event and the information that is made publicly available. For example:

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[12] CMD 22-H8 p. 58 3.11.3.3 Proposed Improvements

[13] Section 6.3 of the S-99 regulatory standard, *Reporting Requirements for Nuclear Power Plants* CNSC March 2003 http://nuclearsafety.gc.ca/pubs_catalogue/uploads/S99en.pdf (Criteria - p. 24, 25)

[14] nuclearsafety.gc.ca/eng/acts-and-regulations/regulatory.../regdoc3-1-1/index.cfm

[15] CNSC CMD 17-H.3 p. 31: Sections 29 and 30 of the *General Nuclear Safety and Control Regulations* outline specific scenarios under which a licensee must file a report to the CNSC.

[16] http://nuclearsafety.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc3-1-1/index.cfm#appA

- The websites of licensees include only a list of events that have occurred at a specific station for a specific year and a report number.[17] No further information is provided as to how to actually access the full reports on any of these events. Thus, the public has no indication as to the cause of the accident/incident; its relative severity; or whether there were releases of radioactive and other hazardous substances that resulted in exposure by workers and/or the public.
- The lists of events exclude those considered to involve confidential or security-based information. While a request can be made for such information under Access to Information, some of that information could still be redacted. This further limits public access to reports of events beyond those submitted under REG 3.1.1. Thus the public is uninformed as to how such events may have affected them.

Despite weaknesses in the system of reporting, these reported events tell us a number of things. Firstly, there are several incidents, irregularities etc., at these facilities, year after year. Some of them could or have resulted in the release highly toxic substances to the environment, both radiological and non-radiological, but there is never an indication of failure to protect and prevent such incidences.

The strangest and most disturbing event deals with shipping, transporting the signs – stolen shipments, misplaced, damaged, fires on site, etc. What else may be going on that is amiss is not necessarily found or included in these reports.

The change in the CNSC regulations as to reporting events and disclosure has meant that the public has no access to details or follow-up reports. Has the change in regulation had a negative impact on the public's ability to access event reports?

With respect to SRBT, the root causes of these events between July 1, 2015 to December 31, 2021, included failure to follow procedures, equipment failures, fires, and transportation mishaps, to name a few.

Reportable Events at SRBT - July 2015-December 31, 2021[18]

Sept. 25, 2015
During maintenance work on the air compressor, an oil hose became disconnected from a pressurized section of the compressor, ejecting a fine mist of oil into the room, and activating the smoke detector and setting off the facility fire alarm.

June 1, 2016

At 1150h, the facility fire alarm sounded, and all personnel evacuated and responded accordingly. The smoke had been detected in the compressor room, caused by friction associated with the entanglement of a failed drive belt on the unit. SRBT increased the frequency of drive belt maintenance from annual to semi-annual as a result of this event.

[17] http://www.brucepower.com/2017-reportable-events/: http://www.brucepower.com/site-updates/

[18] CMD 22-H8 p.20 - Table 4: CMD 22-H. 1p. 96 -97. Specific dates of these events vary slightly between CNSC and SRBT submissions.

Nov. 28, 2016
SRBT reported that a trailer containing 4 pallets of expired tritium exit signs had been stolen while in transport to the SRBT facility in Pembroke. The trailer was stolen while parked in the yard of Sera Global Logistics in Mississauga, Ontario while awaiting further transport. The trailer was reported as being found on December 15, 2016. The carrier and Peel Regional Police inspected the trailer in close consultation with SRBT, where it was determined that the packages had not been tampered with, and remained in good condition for transport. Once the shipment arrived in Pembroke, the SRBT Health Physics Team performed a radiological assessment of the trailer and its contents, finding no evidence of any hazard. An inventory check confirmed that there were no missing exit signs.

June 6, 2017
A package was returned to SRBT with clear evidence of damage in transport. The package was categorized as UN2910, Excepted Package, Limited Quantity of Material, and was destined for a customer located in Bulgaria when it was refused loading for export by aircraft due to the apparent damage to the outside of the package. The package was assessed upon receipt, and although the physical damage was visually evident, an assessment found no radiological hazard associated with the package (i.e., no evidence of contamination, products contained within were still in excellent condition).

November 2017
A contracted freight carrier notified SRBT that they had declared a package containing 26 tritium powered self-luminous aircraft safety signs lost. The package was intended for a customer in Germany, and was categorized as UN2911, Excepted Package, Articles. On December 6, 2017, the carrier informed SRBT that the package had been located in Munich, and delivery to the customer was completed on December 12, 2017.

February 5, 2018
A spent bulk tritium container was transported and delivered to a consignee as a Type ‘A’ package, but was later determined to have contained a Type ‘B’ quantity of tritium. The consignee notified SRBT of this finding after conditioning the tritium container in preparation for filling. As a result, SRBT altered internal packaging procedures to categorize all spent bulk tritium containers as UN2916 Type ‘B’ in the future.

January 2, 2019
SRBT reported that a major fire was in progress at a nearby lumberyard, resulting in a loss of power to a significant part of the City of Pembroke, including the SRBT facility.

January 22, 2019
SRBT erroneously accepted 3 tritium-powered aircraft safety signs from a customer in the European Union. The signs had recently been sold and exported by SRBT in accordance with an export licence. The signs were received by the customer, but after inspection the signs were rejected as they were found to not meet the design requirements for their purpose. The customer sent the 3 signs back without authorization from SRBT, and the shipment was mistakenly accepted upon arrival, without having the required import licence.

February 19, 2021
A fire alarm occurred at the facility at approximately 7:45 am. A malfunction of the compressor generated a small quantity of smoke just prior to the unit automatically shutting down.

August 16, 2021
A fire alarm occurred at the facility at approximately 8:30 am. All personnel were evacuated safely from the facility, and accounted for at the muster point. It was immediately apparent that the alarm was caused by a malfunction of a hand-held, oxy-acetylene torch in Zone 3.

Comments

These events are indicative of a failure of control, for example, leaving a trailer loaded with tritium signs unguarded, failure to meet inspection requirements in other jurisdictions, and noted malfunctions of equipment which resulted in triggering fire alarms.

However, the CNSC (and SRBT) seem to have no concern about such reported events as for all of these events, stating "There was no hazard to workers, the facility or the environment."

On the other hand, the root causes of these "events", cumulatively, speak to an inadequate "safety culture", in sharp contrast to assurances by both SRBT and CNSC staff professing otherwise.

Despite the potential for hazard and harm from exposure to tritium, these events, which are just those deemed "reportable", are summarily dismissed. The impact on the health and environment of the public closest to this facility and the nuclear workers is summarily dismissed. This is a travesty.

GROUNDWATER – MONITORING AND CONTAMINATION

Overview

Groundwater monitoring has been continuously performed by SRBT since 2006. When this program was first implemented (2006-7), 11 monitoring wells exhibited concentrations in excess of 7,000 Bq/l, the Ontario Drinking Water Quality Standard O. Reg 169/03.

SRBT's submission states that:[19]

> "tritium concentrations in monitoring wells across the entire array of sampling wells have continuously been decreasing for several years, as the operational changes that were implemented in the mid- to late-2000s take full effect.
>
> Of the 29 monitoring wells routinely sampled, only a single well located in an access-restricted fenced area very near the stacks exhibits a tritium concentration in excess of the Ontario Drinking Water Guideline value of 7,000 Bq/L. Presently, "Overall, tritium concentrations in wells used for some drinking water exhibit concentrations less than 14% of the Guideline value, and continue to decrease." Based on these monitoring results, SRBT contends that:

[19] SRBT CMD 22-H8.1 p.15

> “Data obtained via the Groundwater Monitoring Program has clearly demonstrated a continued downward trend in the concentration of tritium in groundwater near the facility. For the period 2015-2021, water from 100% of the SRBT monitoring wells has exhibited a significant drop in average annual concentration, ranging from a decrease of 6% at MW07-12 to a decrease of 85% at MW06-1. This data clearly demonstrates the positive effect of the operational changes put in place over the last fifteen years.”[20]

The monitoring well, MW06-10, is the sole well that exhibited a tritium concentration in excess of the Ontario Drinking Water Quality Standard O. Reg 169/03. MW06-10 is an engineered sampling well, drilled specifically for that purpose in September 2006, and has been routinely sampled since. Based purely upon its location, this well is expected to exhibit the most elevated concentration of tritium amongst all other groundwater monitoring wells.

SRBT has noted that the tritium concentration sampled from this well decreased by 42% since 2015 and by 79% since 2006. However, in the year 2020, tritium concentrations in this well exceeded the Ontario Drinking Water Quality Standard by a factor of 4! No explanation has been provided by CNSC or SRBT to explain this “anomaly”, nor is there any indication as to how or what SRBT will be required to carry out to address this issue. No “penalties” have been issued. Certainly, such tritium concentrations should raise serious concerns as to the potential of seepage from this well. One cannot assume that this is a closed system.

This standard, upheld by the CNSC, has been in place for decades. It is, in effect, a permissible standard, not a protective standard, and far out of line of standards for tritium in drinking water in other jurisdictions. It is not the gauge by which one should assess whether this level can even be considered safe enough or protective.

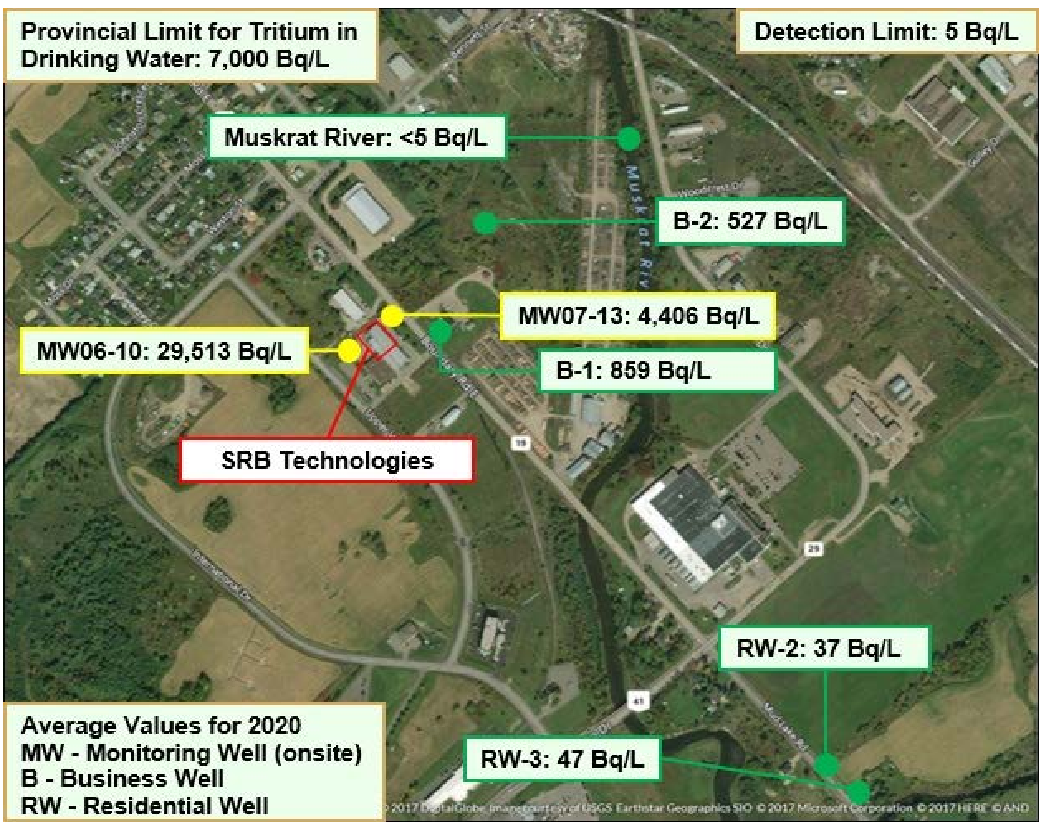
[20] Ibid p. 15

CNSC REPORT ENVIRONMENTAL PROTECTION REVIEW - MONITORING [21]

SRBT monitors tritium in groundwater around the site with 29 surrounding wells, which were sampled monthly until 2020 and then sampled on a quarterly basis onwards. CNSC moved to quarterly sampling at SRBT's request, given the stability of tritium concentrations and overall decreasing trends over the last 15 years. Should groundwater behaviour change in the future, a higher sampling frequency would be reinstated.

In 2020, concentrations of tritium in samples obtained from all wells were below the Ontario Drinking Water Quality Standard value of 7,000 Bq/ with the exception of one well (MW06-10) with a mean groundwater tritium concentration of 29,513 Bq/L. This well is located at the northwestern corner of the facility directly beneath the area where the active ventilation stacks are located. These high tritium concentrations are representative of historical contamination from the site in the early 2000's and wet deposition under normal operational conditions. This well is a dedicated, engineered groundwater monitoring well within a secured area, and is not available for use as a source of water consumption.

Tritium Concentrations around the SRBT facility



[21] https://nuclearsafety.gc.ca/eng/resources/publications/reports/srbt/index.cfm#sec-3-2-3
p. 32,33 Section 3.2.3 Hydrogeological Environment e-Doc: 6549583 (Word) e-Doc: 6621499 (PDF)

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SRBT also samples five nearby residential wells around the site, although none of the residential wells are in the groundwater flow pathway. The closest one, RW-2, is 1,100 metres away from SRBT. The tritium concentrations among the sampled residential wells monitored are currently under 60 Bq/L. The tritium concentrations above the limit of detection in the residential wells are a result of deposition of tritium released into the air, not through groundwater movement from SRBT area.

Tritium concentrations decrease significantly at locations farther away from SRBT through natural processes such as radioactive decay, hydrodynamic dispersion and retardation. Over the years tritium concentrations in the Muskrat River (the receiving surface water environment) have been consistently near or below the minimum detectable activity (MDA) (between 5-10 Bq/L).

Groundwater contamination from the early operations of SRBT were of a concern and have been addressed through several corrective measures (e.g., stopping historical practices of releasing waste water into the ground, reducing air emissions, conducting a comprehensive hydrogeological study and establishing a groundwater monitoring program) and regulatory oversight. During SRBT's licence renewal hearing in 2010, concerns remained regarding the upward trend of tritium in the groundwater around the facility. To address the concerns, CNSC staff conducted an independent groundwater modelling assessment in early 2010's.

SRBT completed another groundwater study in 2011 which confirmed that the elevated tritium concentrations in groundwater well MW06-10 was mainly caused by high tritium concentrations in the soil due to historical practices. CNSC staff's modelling also predicted that while some monitoring wells were showing an upward trend, concentrations would decrease as tritium in the soil is gradually flushed out by infiltrated precipitation, and would eventually stabilize.

CNSC staff continue to assess the groundwater monitoring data collected by SRBT against predicted values using staff's modelling assessment initiated in 2010. Using the two monitoring wells in close proximity to SRBT as an example, the relatively good agreement between the modelling results and measurements provides validation of CNSC staff's 2010 prediction of the behaviors of tritium in the groundwater system around the facility.

According to the CNSC, its assessments have demonstrated that releases of tritium resulting from SRBT's operation are "under control and the tritium movement in groundwater around the SRBT facility is well understood." CNSC staff have thus determined that that tritium concentrations in groundwater have declined and stabilized as predicted.

While that may be the case, it does not necessarily translate into assuming that these releases of tritium do no harm. On the contrary, CNSC staff should be very concerned about the levels of tritium in groundwater and the long-term cumulative impact on the environment.

Of all issues is the setting of "standards" that are typically magnitudes greater than the actual amounts released and thus are irrelevant and ineffective. In particular, maintain an outrageous outdated "standard" for tritium levels in drinking water of 7,000 Bq/l (the Ontario Drinking Water Quality Standard O. Reg 169/03). That must change!

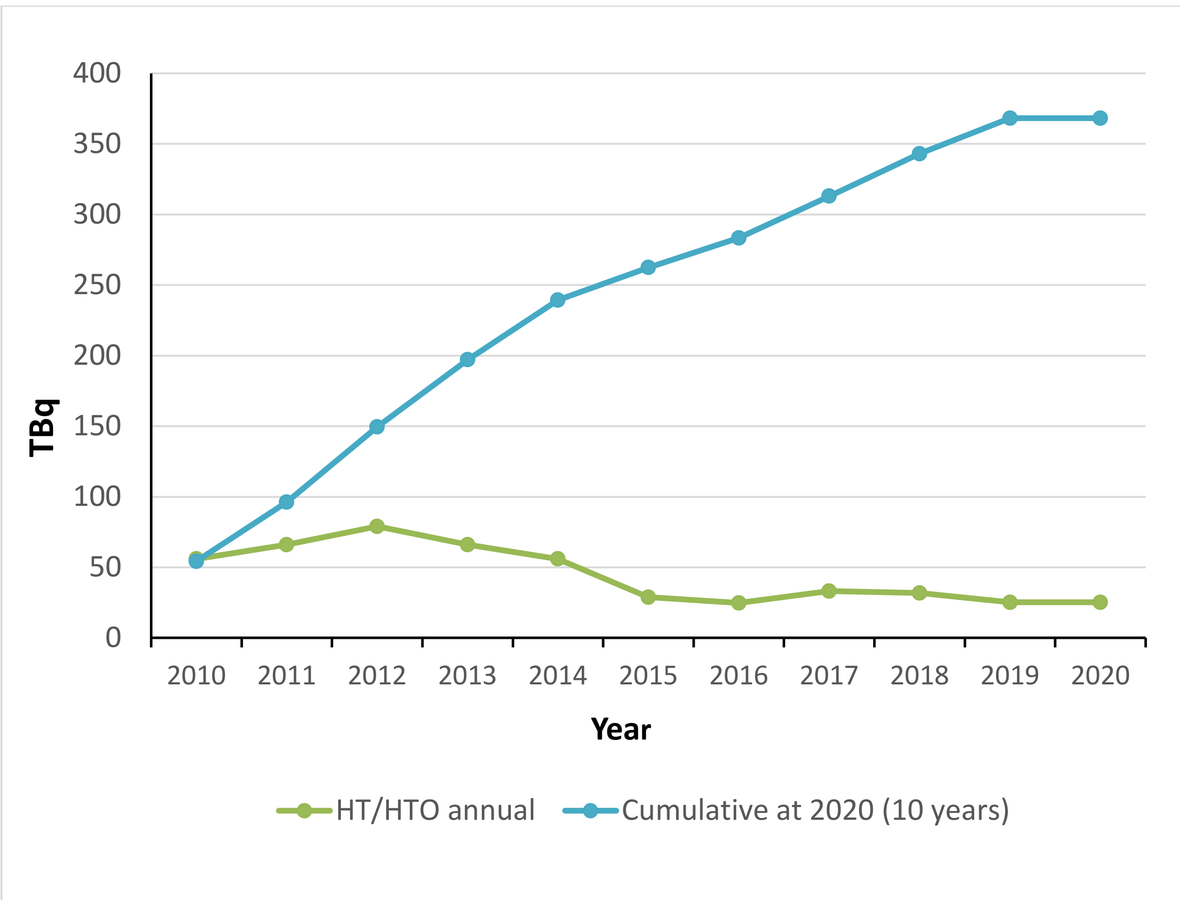
CUMULATIVE EMISSIONS OF TRITIUM (HT AND HTO) - SRBT

Cumulative emissions of tritium are not considered or addressed in SRBT's or CNSC's documents. This is a serious omission. Given that tritium has a half-life of 12.3 years, it will take over 10 half-lives (120 years) for its activity to decay to 1/1000th of its initial level. Over the 10 year period demonstrated in the graph below, only about half of the tritium emitted in the early years has decayed. By 30 years of operation, approximately 18.5% of the tritium that was released at the start of operations will still remain.

The following graph highlights a 10 year period of cumulative tritium emissions to water for the years 2010 to 2020, taking into account the decay of tritium in this period.

Annual and Cumulative Emissions of Tritium (HT and HTO)

TeraBequerels (TBq)



In the previous decade (2000-2010), and especially for the specific years 2004-2006, tritium emissions to air were 4315, 1224, and 285 TBqs respectively. If these emissions are considered, taking into account that the levels of tritium would decrease by approximately half over a 12 year period, the cumulative emissions of tritium overall for the past 20 years would be significantly greater. This cannot be ignored and thus discounted.

CUMULATIVE EFFECTS - OVERVIEW

While a study of cumulative effects is complex, broad-based in scope, and not a precise science, the potential for adverse cumulative effects resulting from operations of a facility must nevertheless be considered and explored. The combination of various factors or stressors occurring over the same time period and location cumulatively could be far more detrimental than the effects of each stressor individually. This has been recognized for decades.

For example, in 1999, the United States Environmental Protection Agency, in its guidance on cumulative impacts assessment, stated:

> "The combined, incremental effects of human activity, referred to as cumulative impacts, pose a serious threat to the environment. While they may be insignificant by themselves, cumulative impacts accumulate over time, from one or more sources and can result in the degradation of important resources."

A similar statement is found in the *Introduction* in *Cumulative Effects Assessment Practitioners' Guide*, prepared for the Canadian Environmental Assessment Agency.[22]

A study of cumulative impacts on human health and the environment resulting from certain activities is multi-dimensional. It is not limited to the actual physical exposure to air pollution, groundwater contamination, etc. It must also consider vulnerable populations in the affected communities, as well as socio-economic factors that these projects entail and the overall well-being of a community in the long-term.

Even if each effect may be considered "insignificant" or "unlikely" to potentially cause an adverse effect, it is the cumulative impact of some and possibly all of these adverse effects occurring the same period of time and location that is the essence of cumulative effects.

It is highly doubtful whether "all" adverse effects can be prevented or mitigated, especially when the possibilities and considerations of adverse effects are limited. It defies logic. Regardless of whether the CNSC and the facilities for which it is responsible consider adverse effects "unlikely", the consequences may not.

Pursuing a cumulative approach may well lead to improved understanding of potentially adverse effects that a project or facility may have, in conjunction with other projects occurring over the same time period and space on an ecosystem that may otherwise be ignored.

Regrettably, no mention of cumulative effects has been made in documents submitted by SRBT or the CNSC for the public hearing regarding SRBT's licence renewal request. Clearly, the potential for adverse cumulative effects does exist and will span over a very long period. The failure to consider or address this is indicative of an unwillingness to acknowledge the potential long-term consequences from the operations of such facilities as SRBT.

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[22] "Consideration of Cumulative Impacts, *"PA review of* National Environmental Policy Act Documents, May 1999, p. 13. https://19january2017snapshot.epa.gov/nepa/cumulative-impacts-guidance-national-environmental-policy-act-reviews_.html Refer to: Cumulative Effects Assessment Working Group a*1.0 Introduction* in *Cumulative Effects Assessment Practitioners' Guide*, prepared for the Canadian Environmental Assessment Agency February 1999.

DECOMMISSIONING ACTIVITIES

Dismantling Contaminated Systems [23]

Specifically, three contaminated systems in the tritium processing area (Zone 3) of SRBT were dismantled and removed in 2019-20.

- Ventilated wooden cabinets (fume hoods) - replaced with modern stainless steel units in the Rig Room;
- A laser-cutting system (last used in the mid-2000s) - removed;
- The reclaim rig - the rig was thoroughly and safely decontaminated, dismantled and removed from the facility. The equipment had been in a continuously shut-down state for a number of years.

The Reclaim Rig was commissioned and installed in the 1990s for the purposes of reclaiming tritium from expired and non-conforming light sources at SRBT. The rig was operated until January 2007 before a decision was made to discontinue its use. The last reclaim operation was conducted on January 29, 2007.[24]

The ventilated cabinetry had been left in-state since that time. While some dismantlement had been performed on certain components within the rig several years ago, the main crushing chamber, gearbox, collection can and some associated tritium gas lines remained in place. A decision was made to dismantle the equipment in accordance with SRBT's change control process (ECR-1002), and to dispose of all associated materials in accordance with SRBT's Waste Management Program (WMP).

The dismantling the equipment and cabinetry began November 11, 2019 and was completed in about two weeks. Accordingly, no safety-related issues or events took place during the project, and the space previously occupied by this equipment is available for other uses.

Approximately 120 kg of metal was recycled, and 58 kg of non-recyclable material was sent to landfill as clearance-level waste. Approximately 430 kg of material classified as low-level waste was generated and stored in four drums for disposal in accordance with SRBT's Waste Management Plan (WMP) in 2020.[25]

SRBT possessed a reported 9.523 kg of depleted uranium (DU) in metallic form at the beginning of 2020. This material was used for tritium traps as part of the production of gaseous tritium light sources.[26] The maximum possession limit is 10 kg, so to all intent and purposes, SRBT's possession amount was at the limit.

All contaminated components in these operations exceeding clearance levels were disposed of as low-level radioactive waste. It is not clear what happened to the DU waste.

What is most disconcerting is the lack of clarity in the matter of disposal, as well as the length of time it has taken for SRBT to deal with this contaminated material.

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[23] SRBT 22-H8.1 p. 75, CNSC CMD 22-H p. 27
[24] 2019 Annual Compliance and Performance Report Section 3.2, 3.3p.63
[25] Ibid
[26] 2020 Annual Compliance Report Section 2.3.4.2 p. 57

Furthermore, there is virtually no information on decommissioning plans either in SRBT's licence renewal request or CNSC's document with respect to SRBT's licence renewal report.

As stated in CNSC's CMD with respect to BWXT's Application for Licence Renewal, "On November 29, 2019, SRBT submitted an updated Preliminary Decommissioning Plan (PDP) and cost estimate for the decommissioning of their facility. CNSC staff accepted the revised PDP, including the cost estimate, on February 3, 2020. The updated cost estimate triggered an update to SRBT's financial guarantee. Accordingly, as review was conducted prior to the submission of SRBT's licence renewal application, it is outside the scope of this CMD as licence renewals do not inherently trigger an update to a PDP."[27]

Decommissioning Plans?

On November 29, 2019, SRBT submitted an updated Preliminary Decommissioning Plan (PDP) and cost estimate for the decommissioning of its facility. CNSC staff accepted the revised PDP, including the cost estimate, on February 3, 2020. The updated cost estimate triggered an update to SRBT's financial guarantee. As stated in CNSC's CMD, "as this review was conducted prior to the submission of SRBT's licence renewal application, and is outside the scope of this CMD. Licence renewals do not inherently trigger an update to a PDP."[28]

The PDP was reviewed and revised for both content and format in 2019. However, several facility changes that were implemented by SRBT during the current licence term, including the addition of a facility extension, and the removal of obsolete equipment and equipment that had reached the end of its serviceable life are not accounted for, which is an omission on the part of the CNSC.

The CNSC requires SRBT to revise its PDP for their facility at a minimum every 5 years or when requested by the Commission or a person authorized by the Commission. CNSC staff expect the next scheduled update of the PDP and associated cost estimate to be in 2024. Of course, this is based on the assumption that SRBT's licence would be renewed, at least for that period.

The SRBT Financial Guarantee (FG) for decommissioning remains fully funded and held in escrow. As of December 31, 2021, the FG is funded to $747,760.51.[29] At this stage, there is no way of knowing if this funding is even adequate for the work required for decommissioning, nor when decommissioning, even at the preliminary level, would commence.

As stated in SRBT's licence renewal request application "Assuming that this application is successful and a long-term licence is issued by the Commission, current projections suggest that operations will remain the same, in line with the considerations made above. There is no set future time frame where it is expected that nuclear substance processing at the facility is to cease, or for the decommissioning phase of the facility life cycle to commence."[30]

In other words, SRBT has no planned end-date for the operation of the SRBT facility.

[27] CMD 22-H8 p. 57
[28] Ibid: The CNSC requires SRBT to revise its PDP for their facility at a minimum every 5 years or when requested by the Commission or a person authorized by the Commission..
[29] The required guarantee of funding is $727,327.00. CMD 22-H8.1 p. 2
[30] CMD 22-H8.1 p.17

TRITIUM - HEALTH EFFECTS

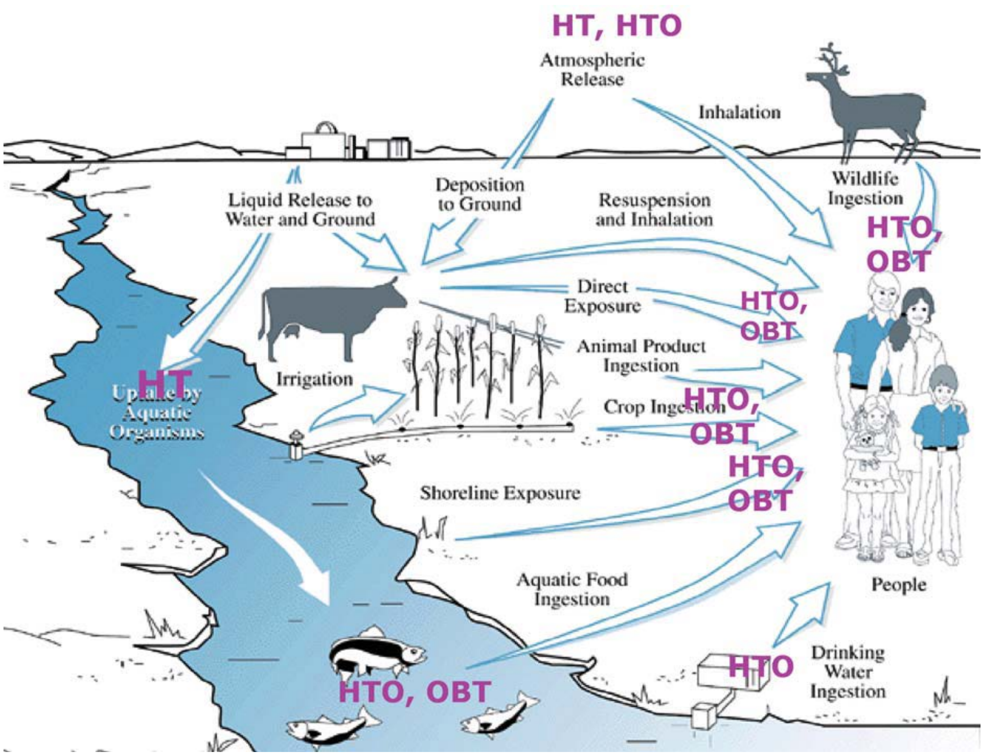
Both gaseous and aqueous forms of tritium (HT and HTO respectively) are very radioactive and pervasive.[31] Its half-life is 12.3 years. HT permeates most materials, rubber and many grades of steel with relative ease, and HTO, which is chemically identical and physically similar to ordinary water, mixes very rapidly everywhere.

Tritium is a carcinogen, mutagen, teratogen, and genotoxin. It is easily absorbed into the body through inhalation, ingestion and dermal absorption. Tritium exchanges easily with H atoms, and binds with organic compounds to form Organic Bound Tritium (OBT), and becomes incorporated into DNA. It disrupts the genetic code of reproductive cells. The cells most at risk would be those dividing at the time of exposure. As it easily crosses the placenta, this raises concern for spontaneous abortions, stillbirths, congenital malformations and diseases.

Since tritium spontaneously disintegrates into a helium atom, the resulting recoil excitation can disrupt chemical bonds. These disruptions when reproduced cause chronic diseases such as allergies or hormonal dysfunction.

A. Environmental Pathways

The following figure demonstrates the numerous exposure pathways:[32]



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[31] One gram of HT contains about 360 TBq of radioactivity, while one gram of HTO contains about 55 TBq.

[32] CNSC 2009: "Tritium Releases and Dose Consequences in Canada in 2006", p.11 http://nuclearsafety.gc.ca/pubs_catalogue/uploads/CNSC_Release_and_Dose_eng_rev2.pdf

Sources of Exposure:

- Plume: Inhalation of HT and HTO
- Soil: Inhalation and dermal absorption of HTO
- Food: Inhalation of HTO and OBT

Exposure variables:

- Location relative to plume
- Duration in the plume area
- Breathing zone height above ground surface
- Inhalation rate
- Amount and type of food grown in initial plume area that is consumed
- Age, sex, etc.

A number of studies in Canada have demonstrated the health detriments of tritium, including an increase in the number of fatal birth defects and neonatal deaths in the area of the Pickering nuclear facility, an increase in Down's syndrome and central nervous system anomalies in births in the Pickering area, and an increase in child leukemia deaths near the Bruce plant. As well, the IARC (International Agency for Research on Cancer) study of Nuclear Workers found that radiation related cancer rates of Canadian nuclear workers are higher than that of other nuclear workers receiving the same radiation dose.[33]

Despite these studies and others in other countries (England, Germany, for example) that should alert regulators to the dangers posed by nuclear operations, denial pervades the regulator, and the industry. The burden of proof is being placed on the people to prove harm, rather than on the industry and government to prove no harm.

B. Organic Bound Tritium (OBT)

While this form of tritium has been well recognized for years, there has been little movement in dealing with the extent to which OBT affects human health and biota. The significance of OBT must be considered and strongly emphasized, as it indicates the extent to which insidious exposure to tritium is detrimental. The following text describes issues related to OBT.

> Tritium rapidly enters all material containing hydrogen. Some of this absorbed tritium reacts with organic compounds and is called organically bound tritium (OBT), a very important component of tritium exposures. When there are repeated (i.e., chronic) exposures to tritium, concentrations of OBT gradually increase in all biota. Humans accumulate OBT by consuming OBT in tritium-contaminated food and by drinking/eating, breathing and absorbing tritiated water (HTO). OBT is more problematic than HTO because of its much longer residence time in the body and because OBT by its very nature is located near organic molecules (for example, DNA).[34]

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[33] Dr. Rosalie Bertell: Health effects of tritium. (*Health Effects of Tritium*, Submitted to the CNSC, (Nov. 27, 2006)

[34] Dr. Ian Fairlie, *Tritium Hazard Report Pollution and radiation Risks from Canadian Nuclear Facilities,* June 2007 http://www.greenpeace.org/raw/content/canada/en/documents-and-links/publications/tritium-hazard-report-pollu.pdf

The OBT fraction of tritiated water has two components. The first, OBT1, is exchangeable, that is, it easily reacts with other chemicals in the internal environment and binds with oxygen, sulfur, phosphorus or nitrogen atoms, to form amino acids, proteins, sugars, starches, lipids, and cell structural material which are then used and 'destroyed' within the body and excreted in time. Since OBT1 has a biological half-life of about 40 days, it will remain in and accumulate with daily ingestion in the body for about that time.

Chronic exposure to tritiated water (HTO) in food will cause an increase in the exchangeable fraction of OBT (OBT1) to approximately the same proportion as HTO, as one would expect in an area such as Pembroke, exposed to extreme levels of tritium pollution for over thirty years from SRB Technologies from its manufacturing of gaseous tritium light sources.

The second more fixed component, OBT2, also referred to as non-exchangeable OBT, binds with carbon atoms of the DNA. OBT2 has a biological half-life of about 550 days. Since the DNA in the cell is not frequently replaced, being bound to DNA will keep the tritium inside the cells for an average of 550 days. The longer exposure time will increase the deposit of energy in a tissue by a factor of three, analogous to sitting in the sun longer and getting a worse burn.

The non-homogeneous distribution of the two OBT components in the body means higher localized absorbed doses, each at least four times higher than the average dose for uniform spread of HTO, which will increase the estimate of energy deposited generally by another factor of three.

C. Dosimetry - International Commission on Radiological Protection (ICRP)

The Sievert is a risk-based unit of measurement of ionizing radiation that estimates the probability that a given exposure will result in a fatal cancer. Basing risk on fatal cancers alone does not mean that other radiation related health effects will not occur.[35]

The ICRP methodology and underlying assumptions for calculating the internal absorbed dose are flawed for a number of reasons. For example;

- ICRP considers that HTO doses from inhalation and ingestion are 25,000 times greater than for HT, because the body is not thought to absorb or metabolize hydrogen gas, whereas water is a vital component of all body tissues and metabolic processes. However, HT dispersed into the atmosphere diffuses readily into the soil and is converted to HTO in soil, the rate of which depends on certain soil conditions such as porosity, water content and microbial activity. The converted HT is subsequently transported as HTO.
- The distribution of OBT in the whole body is assumed to be homogeneous, which is not the case, as it is actually localized in certain tissues.
- Lack of consideration has been given to the greater harm of OBT compared to HTO.

[35] Dr. Rosalie Bertell: Health effects of tritium. (Submitted to the CNSC, Nov.27, 2006)

- The length of time that OBT1 and OBT 2 remain in the human body after long-term exposure to OBT is significantly underestimated. The dose models for tritium do not fully recognise increases in OBT concentrations from repeated exposures.
- ICRP recognizes only severe genetic effects in live-born offspring are not considered, and does not take into account cases such as miscarriage and stillbirth, teratogenic effects, such as congenital malformations or diseases, or childhood asthma.[36]
- Salient factors such as chronic exposure, non-cancerous effects, or the damage done by tritium to DNA, chronic illnesses due to non-functional enzymes, hormones and essential proteins are not considered, despite evidence that these effects occur.
- ICRP applies a Relative Biological Effectiveness (RBE) Factor of 1 for tritium in determining its dose limit, whereas for most government regulations, the RBE for electron and photon radiation is 1, it is 10 for neutron radiation, and 20 for alpha radiation. Based on several factors mentioned above and a consensus of scientific research, the RBE for tritium is severely underestimated.[37]

The ICRP risk-based system of protection relates to "reference persons" and does not take account of age, size and sex differences in risk factors. It ignores the fact that there is no safe level of exposure to radiation and gives scant attention to populations (women and children) who will bear the burden of the risks.

The CNSC study "Health Effects, Dosimetry and Radiological Protection of Tritium" states:[38]

"Tritium beta radiation is about 1.4 times more effective in causing biological effects than x-rays and 2.2 times more biologically effective than gamma ray radiation." This means that the health risk of tritium is respectively 1.4 and 2.2 times higher than these other forms of radiation. "The use of a RBE of 1 in the current ICRP radiation protection framework has not decreased the level of protection afforded to workers or members of the public. This is because implementation of optimization has resulted in exposures to tritium that are very low and well below doses at which an increased risk of cancer has been observed."

The study concludes that:

- Current dosimetry and biokinetic models for assessing dose are acceptable for radiation protection purposes.
- Studies have shown that tritium exposures at current levels in Canada are highly unlikely to cause adverse health effects.
- Canada's current regulatory framework has effectively controlled tritium exposures.

In other words, the status quo is acceptable, despite information clearly indicating otherwise.

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[36] Straume T and Carsten AL (1993): Tritium radiobiology and relative biological effectiveness: Health Phys. 65:657-672.Teratogenic risks for tritium have been estimated to be six-fold higher than the risks of fatal cancers.

[37] **Relative Biological Effectiveness Factor (RBE):** The equivalent dose to a tissue, the Sievert, is found by multiplying the absorbed dose, in gray, by a "quality factor" *Q*, the RBE, dependent upon radiation type, and by another dimensionless factor *N*, dependent on other factors such as the part of the body irradiated, the time and volume over which the dose was spread, and the species of the subject. As per most government regulations, the RBE [Q] for electron and photon radiation is 1, for neutron radiation, 10, and for alpha radiation, 20.

[38] CNSC: http://www.nuclearsafety.gc.ca//pubs_catalogue/uploads/CNSC_Health_Effects_Eng-web.pdf pp. x-xii

CONCLUDING REMARKS AND RECOMMENDATIONS

Summary

This submission has raised several concerns and issues pertaining to the operations of SRBT over the past several years. In particular;

- Limits: The extremely lax tritium release limits to air, water, sewers and the drinking water standard set by CNSC. Even when these inadequate limits have been exceeded in some incidences, neither SRBT nor the CNSC has shown concern.
- Waste: The application of "clearance levels" for radioactive waste has resulted in the disposing of "cleared" radioactive waste in landfills not designed for radioactive-contaminated waste.

Despite all the issues that have occurred from SRBT's operations, the CNSC has indicated its approval of SRBT's 15-year licence request, with no stipulations as to SRBT's practices and operations regarding the levels of tritium releases, or the wastes. Neither has CNSC indicated the necessity for SRBT to prepare and implement a decommissioning plan in its licence application renewal.

Recommendations

As a regulator of nuclear safety, the CNSC must take a far more cautious and prudent route regarding granting SRBT its request for renewal of its operating licence, and in particular, for a licence of 15 years. A renewal of SRBT's operating licence would only continue to exacerbate an unsustainable situation.

Therefore, it is recommended that the CNSC reject SRBTs application for a 15-year licence renewal. Instead, it is recommended that SRBT's licence be renewed for no more than 5 years. During this period, SRBT must be required to develop a **detailed decommissioning plan** that is subject to public review.

It is also critical that the matter of "waste management", including clearance levels, be reviewed, and that all the wastes that would need to be disposed of by SRBT's operations and that decommissioning are carried out with the utmost safety and caution.

Furthermore, it is highly recommended that the CNSC review its tritium standards. Having excessively permissible standards allows for releases of tritium that are inordinately excessive and thus harmful to human health and the environment in the long term.

Correction to the hyperlink provided on pages 20 and 21, on Health Effects of Tritium

(Dr. Rosalie Bertell, November 2006):

Dr. Rosalie Bertell: Health effects of tritium. (Submitted to the CNSC, Nov.27, 2006)