SRB TECHNOLOGIES (CANADA) INC.
320-140 Boundary Road
Pembroke, Ontario, Canada, K8A 6W5
Tel.: (613) 732-0055
Fax: (613) 732-0056
E-Mail: sales@betalight.com
Web: www.betalight.com

Ms. Alison O'Connor
Project Officer, Nuclear Processing Facilities Division
Canadian Nuclear Safety Commission
P.O. Box 1046, Station B
Ottawa, Ontario
Canada
K1P 5S9

Subject: RP Action Level Exceedance – Final Written Report

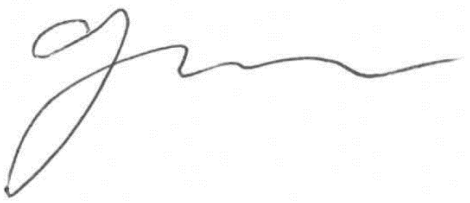
Dear Ms. O'Connor,

Attached please find the final written report on the recent radiation protection-related action level exceedance that occurred at SRB Technologies (Canada) Inc.

An initial report was filed to your attention on March 23, 2026 [1].

Should you have any questions on this subject, please do not hesitate to contact me at any time.

Best Regards,



Jamie MacDonald
Manager – Health Physics and Regulatory Affairs
SRB Technologies (Canada) Inc.

cc: J. Bull, SRBT
R. Fitzpatrick, SRBT
K. Levesque, SRBT
S. Levesque, SRBT

Reference:

[1] Email from J. MacDonald (SRBT) to A. O'Connor (CNSC), *SRBT Notification of Action Level Exceedance – Bioassay Sample,* dated March 23, 2026.

SRB TECHNOLOGIES (CANADA) INC.
320-140 Boundary Road
Pembroke, Ontario, Canada, K8A 6W5
Tel.: (613) 732-0055
Fax: (613) 732-0056
E-Mail: sales@betalight.com
Web: www.betalight.com

FINAL WRITTEN REPORT

Action Level Exceedance – March 23, 2026

Author:

Jamie MacDonald
Manager of Health Physics & Regulatory Affairs

Accepted:

Ross Fitzpatrick, Vice-President

Date Submitted: April 10, 2026

Submitted To: A. O'Connor, Project Officer - CNSC

SRBT FINAL WRITTEN REPORT

Action Level Exceedance – March 2026

Table of Contents

1. Introduction

On March 23, 2026, when reviewing the preliminary results for the routine bioassay samples for the work week of March 16 - 20, 2026, SRB Technologies (Canada) Inc. (SRBT) became aware of a radiation protection-related action level exceedance.

One of the samples, submitted by an SRBT Nuclear Energy Worker (NEW) on March 20, was measured to contain approximately 1,435 Bq of tritium per milliliter of urine. The magnitude of tritium concentration in this sample was confirmed through a repeat assay, leading to the conclusion that the following action level had been exceeded:

PARAMETER: Bioassay result – any sample
ACTION LEVEL: 400 Bq/ml

A preliminary report was made to CNSC staff describing the exceedance, and summarizing the known details surrounding the occurrence.

A commitment was made to file a full, final report on this event no later than April 13, 2026, in accordance with regulatory requirements, and the SRBT Regulatory Reporting Program.

2. Summary of Bioassay Results

The following table presents the tritium concentration in the daily samples provided by the affected employee, and the calculated effective doses associated with those analyses, between March 20 – April 2, 2026:

Sample Provision Date	**[^{3}H]** **(Bq/ml)**	**Effective Dose (mSv)** **(Calculated in accordance with RSO-004)**
20-Mar-26	1428.57	0.2964
24-Mar-26	1200.43	0.3050
25-Mar-26	1157.08	0.0684
26-Mar-26	1083.86	0.0650
27-Mar-26	1038.45	0.0615
30-Mar-26	903.90	0.1690
31-Mar-26	863.02	0.0512
01-Apr-26	821.99	0.0489
02-Apr-26	801.01	0.0471

Including routine exposures received prior to the event, the employee received an effective dose of 1.2162 mSv for the first calendar quarter of 2026, which also represents an exceedance of an action level (0.50 mSv in any quarter).

It is probable that the employee will also ultimately exceed the action level for effective dose in a 1-year period (1.50 mSv) by end of 2026.

3. Issuance of Preliminary Notification

SRBT communicated the action level exceeded by email to the CNSC Project Officer at 1531h that day.

Acknowledgement of the receipt of this notification was provided the following day.

The preliminary notification was posted to the SRBT public website, in accordance with the Public Information Program. This full report will also be posted to this website.

4. Investigation Process Description

The required investigation into the action level exceedance was assigned to the Manager - Health Physics and Regulatory Affairs (HP&RA). A final written report is required to be submitted to CNSC staff no later than 21 working days after becoming aware of the exceedance – by April 13, 2026.

The investigation began with the raising of a non-conformance with the Quality Manager, as required by internal process. Non-conformance report ('NCR') #1045 was generated and assigned to the Manager - HP&RA on March 23, 2026.

A training needs analysis (TNA) was completed, as it was determined that this reportable event included human performance-related factors.

The investigation included interviews with the affected nuclear energy worker, and workers that had observed some of the activities that were performed in the Zone 3 area of the facility the week previous. Data was also analyzed from various sources to determine the specific cause of the exceedance, including contamination control data and tritium-in-air concentrations

The results of the investigation, including the determination of root causes for the events, are discussed in the following sections. Additionally, corrective actions are proposed which, if accepted, will contribute to reducing the probability of similar events occurring.

5. Findings

The investigation has concluded that the following series of contributing events took place on **March 18, 2026**, ultimately leading to the nuclear energy worker experiencing an abnormal intake of tritium.

1. Rig 7 – Abnormal Vacuum Pressure Readings

After concluding a processing operation on Rig 7 shortly after 0800h, the worker identified abnormally elevated readings for vacuum system pressure.

The worker diagnosed that there was likely a problem with the vacuum scroll pump, such that it was no longer able to draw down the system pressure to baseline levels.

2. Pump Removal

To troubleshoot the problem, the worker decided to shut the processing rig down, remove the scroll pump and perform a tip seal change. This is a work activity that occurs frequently in Zone 3, and the worker is qualified and experienced at performing this work.

Around 0900h, the pump was removed from Rig 7 and transferred to the ventilated cabinet (fume hood) in the Tritium Laboratory area of Zone 3 without incident. There is no indication that the contamination intake took place during this phase of the work.

3. Scroll Pump Tip Seal Change

The pump was placed within the ventilated cabinet and the sash brought down to a height that provided space for the worker to handle the pump and to use the tools necessary for the work.

The scroll side of the pump was disassembled at 0905h, exposing both inner scroll surfaces to the negative-pressure environment within the cabinet.

Shortly after, the Bulk Stack tritium concentration began to rise as expected, as displayed on the remote display unit in the room. The peak concentration of tritium in the active ventilation stream occurred at approximately 0915h, and measured 2,870 $\mu Ci/m^3$, well within normal for this task.

After peaking, the concentration trended down gradually and continuously over time, but remained elevated for the duration of the tip seal change.

The tip seals are made of a thin spiral of polytetrafluoroethylene (PTFE). They become increasingly contaminated with tritium during use providing vacuum on processing systems.

The worker proceeded to remove the existing tip seals from the scrolling surface channels on both sides of the pump mechanism. The common practice is to dislodge one end of the tip seal spiral using a small flat-head screwdriver, and then, using a gloved hand, pulling carefully on the freed end of the seal to remove it from the recessed channel in the scrolling surface.

The worn seals were bagged and sealed, and then stored in the drum in the Zone 3 waste room, to be disposed of in the near future as low-level waste by SRBT's qualified radioactive waste services provider. New replacement seals are then introduced manually into the channels of the scroll surfaces, again using gloved hands.

The investigation has determined that the process of performing the scroll tip change is very likely to have been the point where the internal contamination event took place, given that:

- The tip seal change was being conducted on a pump that was very recently taken off a processing system (had been used for an operation that morning);
- The environment inside the ventilated cabinet during work exhibits a significantly elevated concentration of airborne and surface contamination;
- There is a significant amount of manual handling of contaminated materials;
- There are steps in the process where gloves are required to be changed to minimize any cross-contamination of surfaces or items outside of the ventilated cabinet;
- The standard lab coat worn for this work can leave areas near the wrist exposed when reaching for items, or working with items at the back of a fume hood as in this case;
- During this work, a member of the Health Physics Team happened to be in the room performing an unrelated administrative task, and noticed that the worker was not using a 'double glove' strategy in handling the contaminated items and surfaces.
    - The worker was reminded to ensure that when they are performing such work, double gloves are required to be worn. This was acknowledged and complied with immediately.
    - This protection strategy is described in procedure RSO-041, *Protective Clothing for Radiation Safety*.
    - It is also a protection strategy that is discussed with employees during onboarding of new employees, and during annual all-staff training sessions.

4. Pump Re-installation

Once the tip seal changed was completed, the pump was reassembled and tested successfully in the fume hood. The unit was then returned to the Rig 7 cabinet and reinstalled.

The investigation determined that prior to moving the scroll pump from the ventilated cabinet to the Rig 7 cabinet, the external surfaces of the assemble pump are not routinely wiped down to eliminate surface contamination.

This is not likely the primary contributing factor in the intake; however, best practice would certainly be to ensure the external surfaces are decontaminated to a reasonable extent prior to moving the pump back, as the pump is heavy and can be challenging to put in place in the cabinet, resulting in the potential of cross-contamination of the person and/or their protective clothing.

5. **Tip Seal Change Ineffective**

After reinstalling the pump, the processing system was tested for vacuum. The initial symptom persisted – the pressure on the vacuum side of the system continued to exhibit an abnormally high value when the scroll pump was turned on.

At this point, the worker took their break and exited the area by removing shoe covers, their lab coat, and their gloves, and then washing their hands, as per routine practices for contamination control when moving from Zone 3 to Zone 1. The lab coat and shoe covers were not disposed of; they were placed on a hook / in a storage container for reuse by the worker after their break.

The worker also contacted the responsible manager for the SRBT Maintenance Program, who in collaboration with the Project Engineer and the worker, investigated the problem further once the worker's break was completed.

6. **Diagnosis of the Nature of the Problem**

The group was able to determine that the source of the problem was a failed Pirani vacuum pressure gauge. Changing the gauge corrected the problem immediately. It is likely that the pump was fully functional before the tip seal change was conducted – the instrument that measures vacuum pressure was faulty.

Normal processing operations resumed on Rig 7 once the problem was resolved.

6. Review of Similar Historical Events

Historically, abnormal intakes of tritium by SRBT nuclear energy workers have occurred; however, there has not been an intake of a magnitude that required reporting to CNSC staff since 2004, when there were two separate instances of workers exhibiting concentrations of tritium exceeding 1,000 Bq/ml.

In both cases, the intakes were caused by challenges associated with laser-cutting operations, and so there is limited relation between the events in 2004 and that which occurred recently.

Considering the fact that more than 20 years had elapsed since a radiation protection-related reportable event took place, the safety-related performance of the SRBT Radiation Safety Program is considered to have been acceptable; however, improvement and corrective actions will be taken in response to this recent event to prevent recurrence of a similar type of intake by a worker.

With respect to the specific task that was performed, scroll pump tip seal replacement is a routinely performed activity, records of which began to be kept in 2014. Scroll pump maintenance work, including tip seal replacement, has occurred frequently since the changeover from oil-based vacuum pumps to the scroll pumps in 2005-06.

A review of the records since 2014 indicates that there have been 114 instances where a scroll pump was disassembled in order to investigate and/or replace tip seals.

Of these 114 occurrences of this type of maintenance activity, the event described in this report is the first instance where a worker incurred a tritium intake of this magnitude. Typically, a marginal in tritium concentration in bioassay samples is probable.

A review of historical bioassay concentrations in workers who perform this type of activity suggests that when the work is performed in accordance with standard practices and good ALARA strategies, bioassay samples will not exceed ~300 Bq/ml. Typical results after such work are often far lower than this value.

To illustrate, between 2019 – 2026 at SRBT, there have only been six instances where a worker’s routine bioassay sample fell in the range of 100 – 300 Bq/ml. Some of those sample results were unrelated to scroll pump maintenance, and resulted from other work activities in the facility, or from inadvertent breakage of high-activity light sources during handling.

7. Cause Analysis

There are multiple factors that ultimately contributed to the event, and to the magnitude of the internal exposure.

The investigation has identified four significant factors that require action:

1. **Issues with the protective clothing worn during the work.**

    - Double gloves were not worn for a period while performing work with a high probability of contamination, as per RSO-041 and worker training.
    - Lab coats routinely used can leave wrist areas exposed when reaching.
    - Lab coat was used to perform work with a high probability of contamination, but was not disposed of once work was complete, instead being re-used.

    Cause: Deficient protective clothing strategies for work of this nature.

    Proposed actions:

    - Improve the degree of protection offered by protective clothing worn by workers when performing such work.
    - As per the TNA associated with this event, enhanced training for workers on the use of this clothing for such work.
    - Establish a control mechanism for the authorization of such work by the Health Physics Team.

2. **Cross-contamination control deficiencies during the work.**

    - Lab coat was used to perform work with a high probability of contamination, but was not disposed of once work was complete, instead being re-used.
    - Pump was not wiped down prior to removal from fume hood after tip seal change.
    - Frequent glove changes are needed for work performed; however, only a single pair of gloves was worn for some of the work, which increases the possibility of skin contact by a contaminated thumb or finger on a glove.

Cause: Human performance deficiencies in training on ways to prevent cross-contamination, coupled with a lack of Health Physics oversight during the work.

Proposed actions:

- As per the TNA associated with this event, enhanced training for workers on strategies to prevent cross-contamination during non-routine work activities that carry a risk of contamination in Zone 3.
- Establish a control mechanism for the authorization of such work by the Health Physics Team that includes an oversight component during the work.

3. Misdiagnosis of the problem on the processing equipment resulting in elevated-risk work that need not have been performed.

- The pump tip seal change was discovered to not have been necessary after the work was completed.
- The processing run on Rig 7 previously had been successful in terms of vacuum quality.
- Another instrument on the processing rig (the 'Digitech' gauge) can be used to confirm the operability of a vacuum pump, albeit with less precision.
- The pump could have been tested in the fume hood after being removed from the rig, but prior to disassembly.

Cause: Insufficient decision-making process on when to perform a tip-seal change.

Proposed actions:

- Create a process-based decision-making strategy that can troubleshoot this type of problem, and eliminate other potential causes before undertaking work with a high probability of contamination.
- Ensure at least two qualified individuals are involved in the decision to initiate a tip seal change on a vacuum pump.

4. Timing of the tip seal change in relation to when the pump was last used for processing.

- The pump tip seal change was conducted shortly after the pump had been used in active service (i.e. within an hour or so).

- There was an available spare pump that could have been installed on the processing rig.

- Additional time between using the pump for active service and disassembly for tip seal change can decrease the potential contamination hazard.

Cause: Insufficient decision-making process on when to perform a tip-seal change.

Proposed actions:

- Create a process-based decision-making strategy that can make a balanced, risk-informed decision on if a tip seal change is advisable given the operational history of the pump, and the need for the change to be completed.

- Ensure at least two qualified individuals are involved in the decision to initiate a tip seal change on a vacuum pump.

The proposed actions are integrated and summarized in the following section of this report.

8. Summary of Recommended Actions

Action 1: RSO-041, *Protective Clothing for Radiation Safety* will be updated to strengthen the provisions for work activities that carry an elevated risk of significant cross-contamination, including:

- the use of appropriate, disposable double gloves that will not result in exposed skin when reaching out or extending an arm; and
- disposing of protective clothing upon job completion.

Action 2: Updated and improved training will be developed and implemented for workers, focused on:

- the correct use of protective clothing during work that carries an elevated risk of significant cross-contamination;
- strategies to prevent cross-contamination during work that carries an elevated risk of cross-contamination; and
- the identification of both routine and non-routine work activities that carry an elevated risk of significant cross-contamination, for the purposes of engaging the Health Physics team who will provide ALARA guidance and oversight as part of the work.

Action 3: MTC-015, *Vacuum Scroll Pump Maintenance* will be updated to:

- incorporate a process-based decision-making strategy to troubleshoot vacuum-related problems on tritium processing equipment;
- to require two qualified individuals being involved in the decision to initiate a tip seal change on a vacuum pump; and
- to solicit Health Physics team assistance for this work due to the elevated risk of significant cross-contamination.

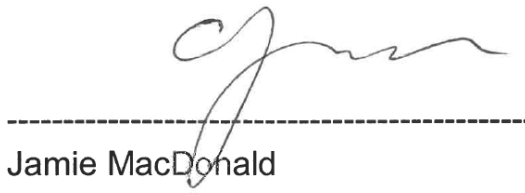
Action 4: Work procedures and processes will be reviewed by the Health Physics team to identify those that carry an elevated risk of significant cross-contamination, and to incorporate an administrative control mechanism for the authorization of such work by the Health Physics Team.

These actions will be tracked to completion and reviewed for effectiveness at an appropriate date in the future via NCR-1045, as per MSP-012, *Corrective Action*.

9. Conclusions

The circumstances of the recent events that contributed to the action level exceedance for concentration of tritium in a nuclear energy worker's bioassay sample, and for quarterly effective dose, have been thoroughly investigated, and recommended corrective actions have been documented.

Completion of these actions will reduce the potential for recurrence of this type of event.



APRIL 10/2026

Jamie MacDonald
Manager – Health Physics and Regulatory Affairs
Investigation and Reporting Lead

April 10, 2026