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## **Update from CNSC Staff**

## **Mise à jour du personnel de la CCSN**

Follow up from April 27, 2021  
Commission meeting

Suivi suite à la réunion de la  
Commission du 27 avril 2021

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**Update from CNSC Staff on  
exceedance of the annual dose limit  
for a Nuclear Energy Worker at  
Jubilant DraxImage**

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**Mise à jour du personnel de la  
CCSN au sujet du dépassement de  
la limite autorisée pour un  
travailleur du secteur nucléaire à  
Jubilant DraxImage**

Commission Meeting

Réunion de la Commission

**October 5, 2021**

**Le 5 octobre 2021**



MEMORANDUM NOTE DE SERVICE

To  
À

M. Leblanc  
Commission Secretariat  
cc: Ramzi Jammal

From  
De

Karen Owen-Whitred *KOwen-Whitred*  
Director General  
Directorate of Nuclear Substances Regulation  
Canadian Nuclear Safety Commission

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Subject  
Objet

Update on Event at Jubilant DraxImage Inc. involving high radiation dose to the thyroid of a Nuclear Energy Worker

**Summary**

This memo provides an update to the Event Initial Report (EIR) delivered verbally during the Commission proceeding on April 27, 2021, regarding a Nuclear Energy Worker at Jubilant DraxImage who received a high radiation dose to the thyroid after cleaning up a spill of iodine-131 (I-131). The original exposure was due to a gap in the licensee’s procedures, which didn’t require workers to wear respirators at a certain step of the clean-up. By contrast, the ultimate thyroid uptake was due to the worker not following procedures, which did specify monitoring within 2-4 hours of the spill. If the monitoring had been performed as required by the licensee’s procedure, the worker would have received stable iodine tablets that could have reduced the amount of I-131 in the worker’s thyroid. The licensee has taken corrective actions to address these issues, which the CNSC has approved. The CNSC has already shared lessons learned with other licensees and is looking at revising licence conditions to further clarify expectations around thyroid monitoring.

**Background**

In the morning of April 20 2021, the CNSC duty officer received a call from the radiation safety officer (RSO) from Jubilant DraxImage, a nuclear substance processing facility that makes iodine and other radioisotopes for medical applications located in Montreal, QC. The location of the facility is shown in Figure 1 below.

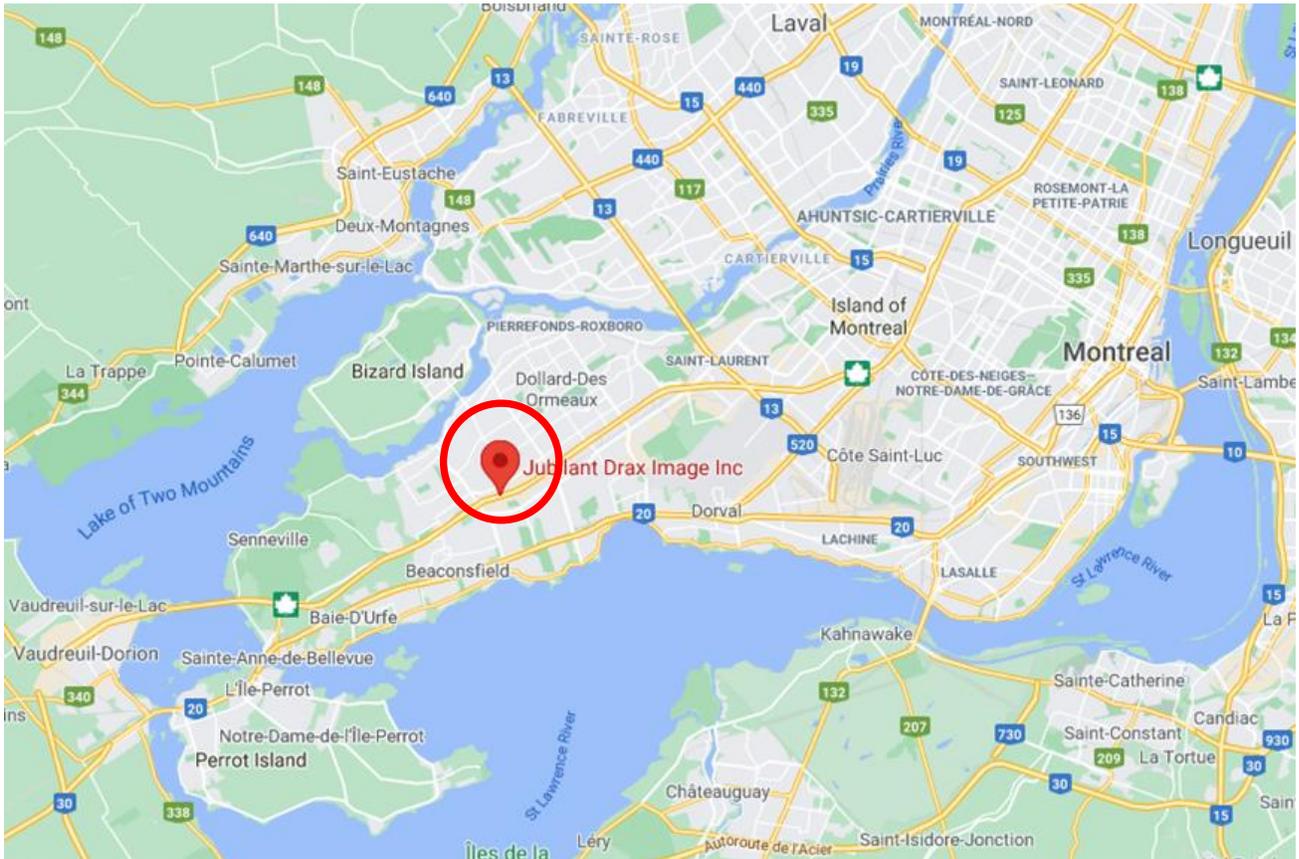


Figure 1: Location of Jubilant DraxImage

The RSO informed the duty officer that a lead pot containing a vial of iodine-131 (I-131) was brought into a ventilated radiation shielded box (Figure 2) on April 19, 2021. A hook was used to remove the lid from the lead pot and the lid of the lead pot fell from the hook directly onto the vial containing I-131, breaking the vial and causing a spill inside the shielded box (Figure 3).



Figure 2: Shielded box Where the Spill Occurred

The spill occurred in a production area for a product where workers are required to wear respirators at all times. In this particular production area there are four rooms and one corridor; all are part of the production area clean rooms.

There was one production worker present at the time of the spill; that worker exited the room and notified his supervisor who immediately notified the RSO. The RSO immediately restricted access to the production area and discussed with the worker the details of the incident. The RSO then went to the room with his assistant and both were wearing respirators. The RSO entered the room to measure the dose rate and evaluate the situation, while the assistant remained in the clean corridor. The RSO removed the lead pot containing the broken vial and the glass debris from within the shielded box and then placed them in a plastic bag in a shielded cart. The shielded cart

was transferred to the assistant in the hallway to transfer the waste to the waste storage room. The assistant removed his respirator when he left the clean rooms of the production area to transfer the waste to the waste storage room.

The licensee performed the initial cleanup to remove the bulk of the spill to prevent the I-131 from overloading the exhaust filters. If these filters are overloaded, their efficiency to absorb gaseous I-131 is reduced and it may cause I-131 to be released into the atmosphere. Draximage added this requirement for immediate cleanup to their program after a similar event in November 2019 led to a release of I-131 in exceedance of their licence limit. CNSC staff reported this event to the Commission on December 12, 2019 CMD 19-M50.

After the cleanup, the licensee performed air sampling in the room. As a consequence of the spill and the nature of the nuclear substance, the ambient concentration of I-131 in the room quickly became elevated and all workers were removed from the production area.

The licensee brought a portable iodine filtration unit (Figure 4) into the room to reduce the airborne concentration of I-131. Approximately two hours later the I-131 concentration had reduced to 16% of the original concentration. The RSO and his assistant returned, wearing respirators, to clean up the interior of the shielded box, which they completed within 15 minutes.



Figure 3: Lead Pot Containing Broken vial inside the shielded box



Figure 4: Portable Iodine Filtration Unit

Once the cleanup was completed, the production worker and the RSO had their thyroids screened to detect any intakes of radioiodine and all results were below the instrument's detection limit.

In the morning of April 20, 2021 the assistant, who did not conduct thyroid screening on April 19, underwent the screening. The measured activity was 501,400 Bq. The licensee requested an immediate reading of the employees' external dosimeters. The result for the external whole body dose for April was 0 mSv; this reading included the dose for the day of the event.

CNSC staff initiated an evaluation of the available information upon the notification by the licensee of this event. The CNSC requested that the licensee perform thyroid monitoring each day for the 10 days after the incident with the results reported to the CNSC daily. The licensee performed 14 thyroid screening measurements over an 11 day period, leading to an estimated committed effective dose to the employee of 29 mSv with a 573 mSv equivalent dose to the thyroid.

CNSC staff independently calculated the individual's committed effective dose and committed equivalent dose to the thyroid by applying the thyroid measurements provided by Draximage to the International Commission on Radiological Protection's dosimetric and biokinetic models for soluble iodine compounds. The licensee's assessment of the employee's committed effective dose is similar to the results obtained by the CNSC of 28 mSv. CNSC staff calculated the committed equivalent dose to the worker's thyroid to be 560 mSv.

### **Additional Monitoring**

In addition to the daily thyroid monitoring performed by the licensee, CNSC staff recommended that additional monitoring be performed by Health Canada's Radiation Protection Bureau. The purpose of these measurements was to provide an independent validation of the licensee's thyroid measurement results and to assess the spatial distribution of the I-131 within the body in order to confirm that the I-131 activity was mostly deposited in the thyroid. The employee agreed to perform the additional monitoring, which took place on April 26<sup>th</sup> and 30<sup>th</sup>. Health Canada's Radiation Protection Bureau informed the CNSC of the results of the monitoring, which indicated that the vast majority of the I-131 activity was found to be deposited in the employee's neck region, with very low levels in the abdominal region. This confirmed that the I-131 was mainly in the thyroid, which is consistent with the inhalation of a volatile iodinated compound such as NaI. This also confirmed that measurement of the thyroid was the appropriate monitoring method to determine the committed effective dose.

The results of the two thyroid measurements performed by Health Canada's Radiation Protection Bureau were also very similar to the licensee's results.

While there is little to no evidence of increases in thyroid cancer risks among persons exposed to radiation as adults, the risk of non-malignant thyroid diseases is less clear. Significant dose-response relationships have been demonstrated for structural thyroid diseases such as benign nodules and follicular adenomas. However, the effects of radiation on functional thyroid diseases, like hyperthyroidism or hypothyroidism is varied. In general, adverse health effects reported in the scientific literature are typically associated with larger intakes than experienced in this situation.

Out of an abundance of caution, CNSC staff recommended medical follow-up for the worker with the objective of detecting any potential future adverse health effects, particularly structural thyroid diseases.

The exposed employee met with his family doctor who prescribed a list of tests to diagnose possible thyroid malfunctions. The licensee's corporate doctor is aware of this case and is communicating with the family doctor about this case. As of July 23, 2021 there have been no effects or sign of thyroid malfunction. The doctor is continuing to investigate and is requesting additional blood tests.

The licensee continued to monitor the thyroid of the employee until the measured activity in the worker's thyroid was below the licensee's 1 kBq alert level. The employee's activity level dropped below 1 kBq around the middle of June 2021. On July 16, 2021 the licensee submitted a return to work authorization request to the CNSC. The worker was authorized to return to work by the CNSC Designated Officer on July 21, 2021.

The licensee submitted a dose change request form to account for the additional dose committed to the affected employee from this exposure. CNSC staff approved the dose change request and the National Dose Registry was notified that the dose may be added.

## **Investigation and Corrective Actions**

As required by the *Nuclear Substances and Radiation Devices Regulations* 38(2), the licensee is required to submit a full report within 21 days of the event. The report must include a description of the situation; the probable cause of the situation; the actions that the licensee has taken to re-establish normal operations; the actions that the licensee has taken or proposes to take to prevent a recurrence of the situation; and the effective dose and equivalent dose received by any person as a result of the situation. The licensee submitted a full report on the event to the CNSC on May 10, 2021 with an update to this report on May 12, 2021. CNSC staff reviewed the information provided in the final report and requested additional clarification and information in order to obtain a better understanding of the sequence of events following the incident and steps taken by each worker involved.

The licensee identified corrective actions to prevent recurrence of a similar event and is in the process of implementing these corrective actions.

An investigation conducted by the licensee identified that the spill could have been avoided if the lid of the lead pot had not fallen. This happened because the hook used to hold it was not secure. The hook used to hold the lid of the lead pot has been changed to a double hook system to ensure that the lid can be securely held at all times without the risk of falling.

The initial spill of I-131 should have been reported immediately since this event would have been classified as a major spill. The spill occurred on April 19 but the event was not reported until the following day. The licensee's internal policy requires immediate reporting of these events to the CNSC and all licensees are required to notify the CNSC of a major spill event immediately as required by the *Nuclear Substances and Radiation Devices Regulations* 38(1). The licensee has committed to ensuring that any future reportable events are reported immediately to the CNSC.

The licensee's investigation focused on the duties of the employee that had the high thyroid monitoring results. The investigation found that the employee had removed his respirator when the waste was moved from the production area to the waste room. The employee manually transferred the bag containing the I-131 waste to another plastic bag and placed it in the shielded bunker. This manipulation, although performed quickly, is likely the explanation why inhalation of I-131 took place. The investigation found that there was a gap in their procedures that does not specify that a respirator should be worn while transferring the waste from one area to the waste storage room. A directive has been issued to production supervisors on the obligation for employees to wear respirators when handling I-131 radioactive waste. In addition, the licensee revised their Radiation Safety Manual to add that it is mandatory to wear a respirator when transferring waste from a production room to the waste storage room.

Section E.2.2 of REGDOC-2.7.2 Vol. 1: *Ascertaining Occupational Dose*, recently approved by the Commission, highlights the importance of completing thyroid screening as soon as possible after a spill or upset condition involving the iodine in which there is the potential for an internal exposure as well as the use of thyroid blocking agents. As reported at the Commission Meeting in April, the licensee's internal procedures requires employees to perform thyroid monitoring within 2-4 hours after any spill. The employee did not perform thyroid monitoring within this time period. An earlier thyroid monitoring on the day of the event may have enabled the licensee to provide stable iodine tablets for the employee that could have reduced the amount of I-131 in the employee's thyroid. Refresher training was provided

to employees to remind them of the licensee's program requirements for thyroid screening within 2-4 hours of any suspected incident involving I-131.

The CNSC has communicated with licensees that are handling large amounts of volatile iodine to make sure they were aware of the event and to ask for details on their procedures for dealing with spills and if the procedures contained immediate thyroid monitoring. The CNSC is also reviewing Licence Condition # 2046 Thyroid Monitoring to clarify the expectations for when thyroid monitoring should be performed taking into account the information provided section E2.2 of REGDOC-2.7.2 Vol. 1, Ascertaining Occupational Dose.

### **Additional Information**

On June 23, 2021, there was another spill of I-131 inside a shielded glovebox for this licensee. The spill in this event was not related to the lead pot lid falling on the vial as in the first event, but was instead caused by a vial that was not stoppered correctly. The stopper came off when the vial was heating and volatile I-131 was released into the shielded box. Following the lessons learned from the incident on April 19, 2021, the RSO performed the transfer of the I-131 waste and ensured that his respirator was on until the waste had been safely stored in the waste room. All employees involved in the incident performed thyroid monitoring on the day of the incident, shortly after the incident occurred, and within their internal procedure requirements. None of the results were above an action level for thyroid monitoring. In addition, the CNSC was notified of the event immediately after the event occurred as required by the *Nuclear Substances and Radiation Devices Regulations* 38(1).

### **Conclusion**

CNSC staff reviewed all information provided by the licensee and CNSC staff are satisfied with the corrective measures put in place by the licensee to prevent reoccurrence. CNSC staff are planning compliance activities with the licensee in Q3 of 2021/22 to verify implementation of the corrective measures.