Department of Primary Industries
Office of Water

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Discharge of human waste containing Iodine-131 from nuclear medicine facilities to sewerage systems in non-metropolitan NSW

This Circular provides guidance for NSW local water utilities (LWUs) and nuclear medicine facilities in regard to the discharge of human waste containing Iodine-131 from hospitals or private practices with nuclear medicine facilities in non-metropolitan NSW. The Circular applies only to nuclear medicine facilities using Iodine-131 for treatment of patients for thyroid disease and was prepared in consultation with the NSW Radiation Advisory Council.

Iodine-131 is used in medical imaging procedures and in treating thyroid disease (refer to the attached Trade Waste Information Sheet 1). Most patients return to their residence immediately after treatment. However, some patients treated for thyroid cancer may be required to be isolated in a hospital for 2 to 3 days in order to limit public exposure to radioactive material. As noted in Information Sheet 1, Iodine-131 is excreted with bodily fluids during this time.

Healthcare facilities using radioactive substances must comply with the *Radiation Control Act 1990 and the Radiation Control Regulation 2003.* In accordance with Division 4, Clause 24(1) of the *Regulation,* the occupier of any premises on which radioactive substances are kept must maintain a record of all radioactive substances discharged from the premises. These nuclear medicine facilities are licensed by the Environment Protection Authority (EPA), however, the licence conditions do not address requirements for the discharge of human waste from the facilities where patients undergo radiotherapy treatment.

In order to address the risk of exposure of LWU employees to radioactive materials in the sewer due to discharges containing Iodine-131, the NSW Office of Water has engaged an independent expert to assess and report on the potential risks through a desk-top study. The study report is based on the existing nuclear medicine facilities using Iodine-131 for treatment of thyroid disease in non-metropolitan NSW and is available on request (padmini.vitharana@water.nsw.gov.au).

The main conclusions of the study report are:

- The estimated annual exposure dose to a worker at the sewage treatment works due to the discharge of human waste from nuclear medicine facilities assessed in this study is not noticeably different to the expected annual natural background radiation level of 1.5 mSv per year.
- The estimated exposure doses for workers at the sewage treatment works are below the legislated annual dose limit of 1 (one) mSv per year for a member of the public.
- The estimated exposure doses for workers performing sewer maintenance work **immediately downstream** of a nuclear medicine facility (eg. at the boundary trap) are below the legislated annual dose limit of 1 (one) mSv per year for a member of the public. These estimates are based on the assumption that such maintenance work is carried out once per year over a period of 4 hours.

- The calculated minimum dilution in the sewer required to ensure that doses for workers performing maintenance on a sewer immediately downstream the nuclear medicine facility remain below the 1 mSv annual dose limit is 4 kL over 4 hours. The calculated minimum dilution stated above is based on the following assumptions:
  - two patients per week are staying in the hospital after being treated for thyroid carcinoma concurrently
  - typical activity level administered to a patient is about 4170 MBq
  - sewer maintenance work is carried out once per year for a period of 4 hours around the time of treatment.
- As the doses calculated in the study are not distinguishable from the expected variations in the level of natural background radiation, the report concluded that no special pretreatment of human waste containing Iodine-131 is necessary. These results support the position stated in the Safety Guide for Radiation Protection in Nuclear Medicine (2008), Radiation Protection Series No. 14.2, that radioactive excreta may be released direct to a sewer system, although the relevant regulatory authority may require the use of a delay tank in certain circumstances.

Recommendations

Regulatory authorities, employers and operators of nuclear medicine facilities which may lead to exposure to radiation have responsibilities to ensure proper radiation protection. While the study indicates that no pre-treatment of human waste from nuclear medicine facilities containing Iodine-131 is necessary, the ALARA principle ("As Low As Reasonably Achievable") needs to be applied by the LWU and the operator of a nuclear medicine facility in order to protect the LWU personnel. Accordingly, the following procedures are to be applied:

A. Local Water Utility

A1. LWUs need to be aware of any nuclear medicine facility in their area administering Iodine-131 for the treatment of thyroid disease. The LWU may need to contact local hospitals and enquire whether this treatment is carried out and if patients are staying in the hospital following the treatment.

A2. The LWU is required to advise the NSW Office of Water if treatment for thyroid cancer involving Iodine-131 is conducted by a nuclear medicine facility in its area. Similarly, the Office of Water needs to be advised of any new proposal for a nuclear medicine facility to carry out this treatment.

A3. If maintenance is required on a sewer main immediately downstream of such a nuclear medicine facility, the LWU needs to contact the facility and ascertain whether any patients are staying there following treatment with Iodine-131. It is recommended that sewer maintenance work is delayed for at least two days after the last procedure. This is to ensure that the prospective radiation dose is not noticeably greater than the expected background radiation levels (refer also to point A4 below).

The LWU needs to schedule maintenance work immediately downstream of such a nuclear medicine facility in consultation with the facility. The LWU must notify the responsible person at the nuclear medicine facility of any planned maintenance work to be carried out downstream of the facility and request that no new treatment procedure be commenced during the maintenance work. The LWU is to advise the facility on completion of maintenance work. Patient wellbeing must not be compromised and routine maintenance work may need to be re-scheduled, if treatment with Iodine-131 for thyroid cancer is required during the scheduled maintenance work.

A4. If there is an existing holding tank for human waste from these facilities, maintenance work on the internal sewer line downstream of the nuclear medicine facility is to be carried out after the tank has been emptied into the alternate tank and/or tank contents are prevented from discharge to the sewerage system.

A5. If delaying sewer maintenance work is impractical (eg. clearing a sewer choke), the LWU needs to keep a record of its personnel involved, date and time of the last administration of Iodine-131 (as obtained from facility records), time spent on maintenance work and the distance between the nuclear medicine facility and the exposure point.

B. Nuclear Medicine Facility

B1. A nuclear medicine facility using radioactive substances must comply with the *Radiation Control Act 1990 and the Radiation Control Regulation 2003* including maintaining appropriate records in accordance with clause 24 of the above Regulation.

B2. Should sewer maintenance work be required downstream of the nuclear medicine facility, the facility needs to provide all necessary information in regard to the number of patients treated for thyroid cancer with Iodine-131 and the dosage and time of administration of Iodine-131 to the local water utility (LWU) on request (refer to recommendation A3).

B3. A dedicated toilet needs to be provided in the area where the treatment is administered and/or patients are staying following treatment. These toilets must be single flush units with preferably at least a 9 L cistern in order to maximise dilution.

B4. Patients should be instructed to flush the toilet twice on each occasion as a safety measure for sewerage system workers and/or private contractors. A sign reminding patients to do so should be displayed in the toilet.

B5. The nuclear medicine facility is not to administer Iodine-131 for treatment of thyroid cancer during pre-arranged maintenance work on the sewer main downstream of the facility without advising the LWU on the required treatment.

B6. If there is an existing holding tank for human waste from these facilities and maintenance work is to be carried out downstream LWU sewer main, the nuclear medicine facility is to ensure that the tank contents are prevented from discharge to the sewerage system during maintenance work.

B7. Maintenance work on the existing holding tanks and/or the sewer main within the nuclear medicine facility should be carried out in a manner that minimises exposure of private contractors who undertake such work to radioactive material (eg. by emptying the holding tank prior to maintenance).

B8. When designing a nuclear medicine facility, provisions should be made for the future installation of holding tanks, so a tank could be installed with minimal disturbance, (eg. by providing a flange on a sewer line). If there is a significant increase in the number of administrations, an increase in the administered activities and/or a change in regulatory requirements, a risk assessment must be undertaken to determine whether continued discharge directly to the sewer is acceptable or if the installation of holding tanks is necessary. Such an assessment is to be made with the consultation with the LWU and the NSW Office of Water.

B9. Nuclear medicine facilities need to advise the LWU of any significant change in their practice of administration of Iodine-131 for treatment of thyroid cancer.

Further information on this matter is available from the NSW Office of Water by contacting Mrs Padmini Vitharana, Trade Waste Coordinator on 8281 7429 or padmini.vitharana@water.nsw.gov.au

Yours sincerely

David Harriss
Commissioner
NSW Office of Water

Encl

Iodine-131

What is Iodine-131?

Iodine-131 is an unstable form (isotope) of Iodine, with a half-life of 8 days, meaning it loses half of its radioactivity in 8 days and will decay in the environment in a matter of months.

What is Iodine-131 used for?

Iodine-131 is mostly used for medical purposes. It is widely used in medical imaging procedures (eg. kidney blood flow) and in treating of the thyroid gland deceases, such as thyroid cancer and hyperthyroidism.

Iodine-131 is administered to patients in the form of sodium iodide (NaI) capsules for the treatment of hyperthyroidism and thyroid carcinomas.

How is the radioactivity of Iodine-131 measured?

The Becquerel (Bq) is a unit used to measure radioactivity. One becquerel (1Bq) is defined as the radioactivity in which one nucleus decays per second. The activity level administered to patients is measured in MBq (1 MBq = 1,000,000 Bq).

A survey of NSW healthcare facilities has identified that the typical activity level of Iodine-131 administered is in the range of 400 MBq to 600 MBq for hyperthyroidism and 4000 to 7650 MBq for thyroid carcinomas.

The unit of sievert (Sv) is used for assessing the level of risk of radiation exposure. It is commonly expressed as a millisievert (mSv), (1 mSv = 1/1000 Sv) or microsievert (μSv)
(1 μSv = 1/1,000,000 Sv).

Background radiation levels

Most of the background radiation level in Australia is due to radiation of terrestrial, cosmic and internal origin. Due to the local geology and our mode of living, the total average effective dose from natural background radiation (excluding medical sources) within Australia is generally below the world average and is estimated to be 1.5 mSv in a year.

Exposure limits

Annual dose limits for public exposure to ionising radiation are legislated in Schedule 2 of the *Radiation Control Regulation 2003.* The annual dose limit for a member of the public is 1 mSv excluding the background radiation level.

Iodine-131 in the body

After Iodine-131 is administered, it is absorbed into the bloodstream and then distributed to various parts of the body. The delay in absorption is between 10 to 15 minutes and complete absorption of Iodine-131 takes about 1.5 to 2 hours. Following the treatment, Iodine-131 is excreted mostly with urine (97%) and smaller amounts through fecal excretion (2%).

ALARA Principle

ALARA principle is a principle of radiation protection meaning that the exposure to ionizing radiation should be "As Low As Reasonably Achievable", taking social and economic factors into account.

As indicated in the *Radiation Control Regulation,* the effective dose to the public must not exceed 1 mSv per year. The patient is kept isolated in the hospital, if this dose can be exceeded by contact with this patient. The patient may only be released from the hospital when the radiation declines to an acceptable level as assessed by a medical specialist.